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ABSTRACT

These proceedings contain the complete papers presented at a world conference convened in Mexico City, April 1979, to discuss the topic of continuing education (CE) for engineers. Additional papers in the proceedings are intended to give a fuller set of ideas on a given topic and provide a basis for discussions with their authors. The report is divided into conference sessions in which papers and related panel discussions are grouped according to general topics of interest. These include the following: (1) the super industrial revolution: (2) adult motivation: (3) CE and the government: (4) professional society programs: (5) university programs: and (6) industry/government programs. Other sessions are devoted to areas of specific interest which are not covered in detail under the preceding topics. A comprehensive and authoritative exposure to media-based CE for engineers is presented in a workshop format. Included are photographs, biographical information, and addresses for all of the authors, session chairmen, and other key persons involved in organizing the conference. (Author/CS)

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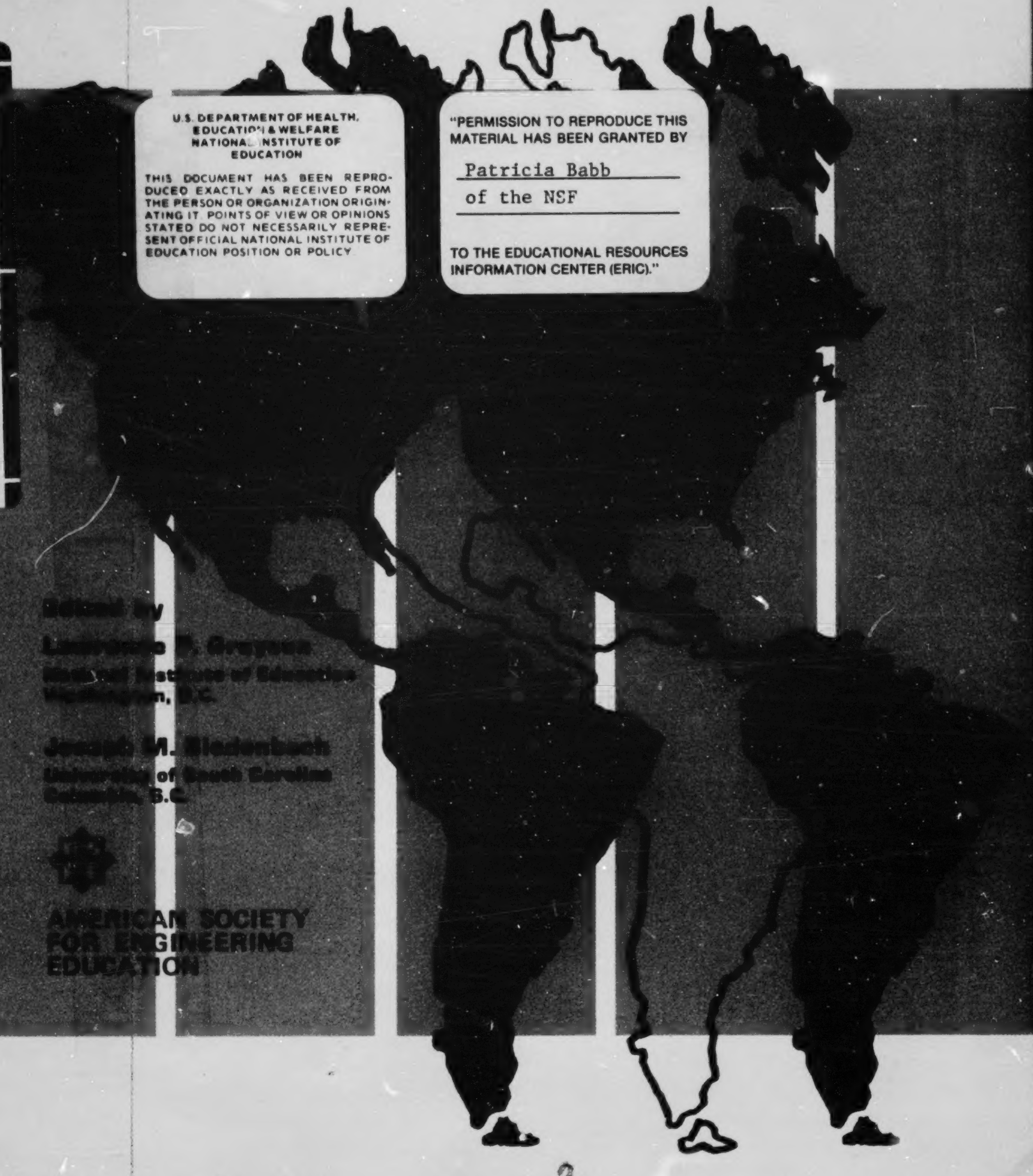
1st WORLD CONFERENCE ON CONTINUING ENGINEERING EDUCATION

PROCEEDINGS

MEXICO CITY/APRIL 25-27, 1979



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AMERICAN SOCIETY
FOR ENGINEERING
EDUCATION

SE 033 417

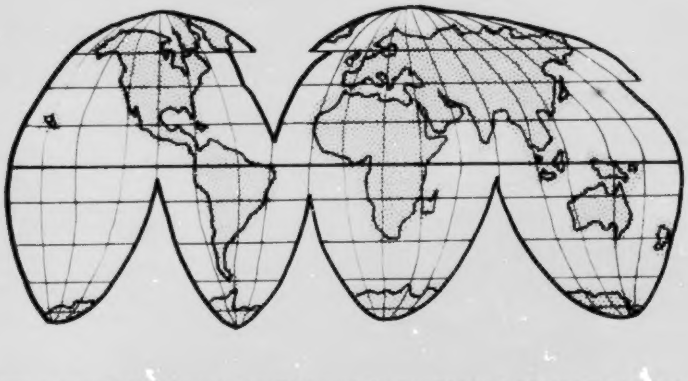
2

PROCEEDINGS

FIRST WORLD CONFERENCE ON CONTINUING ENGINEERING EDUCATION

MEXICO
April 25-27, 1979

Editors:
Lawrence P. Grayson
National Institute of Education
Joseph M. Biedenbach
University of South Carolina



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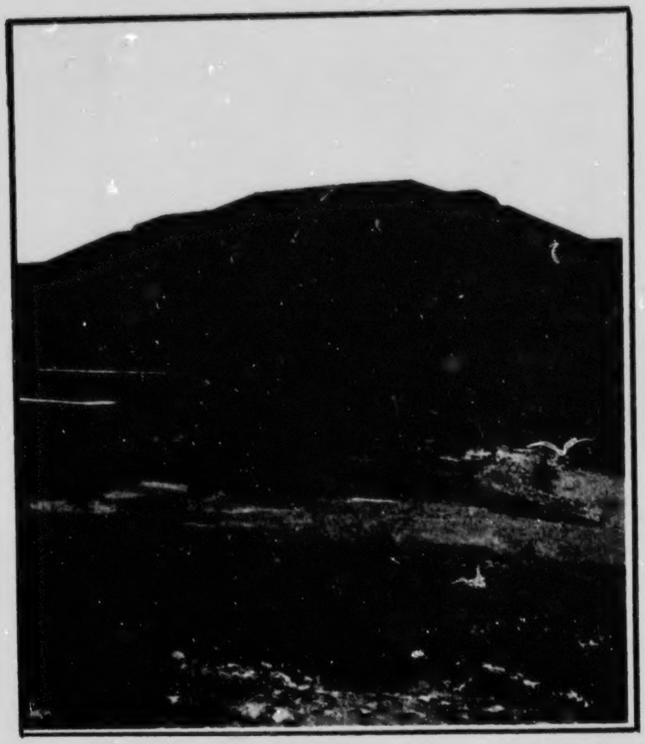
The organizing committee of the World Conference is grateful to the Exxon Education Foundation for providing the funds to publish these proceedings.

PROGRAM AT A GLANCE

First World Conference on Continuing Engineering Education
Mexico City — April 25-27, 1979

TIME	TUESDAY April 24, 1979	WEDNESDAY - APRIL 25, 1979		THURSDAY - APRIL 26, 1979		FRIDAY 27, 1979		TIME
		Session	Topic	Session	Topic	Session	Topic	
8:30 - 10:30 A.M.	CONFERENCE REGISTRATION - CAMINO REAL HOTEL 9:00 A.M. TO 8:00 P.M.		INAGURATION OF CONFERENCE AND EXHIBIT (9:00 - 10:00 A.M.)	4A	PROFESSIONAL SOCIETY PROGRAMS • A National Program • The Swedish Civil Engineers Plan • Technician Training • Professional Societies and Continuing Education in India	6A	GROUP I • The Importance of Continuing Education For Inspectors • Measuring The Effectiveness Of A Joint Thai - Japan Program • Appropriate Education For Nigerian Engineers • Sanitary Engineering For World Health (TDS)	8:30-10:30 A.M.
		1	THE SUPER INDUSTRIAL REVOLUTION ALVIN TOFFLER AUTHOR: FUTURE SHOCK	4B	UNIVERSITY PROGRAMS • A Latin American Center • Industry-University Relations For A Successful Program • The University of Wisconsin Model • Continuing Education In Socialist Countries	6B	GROUP II • Engineers/Managers in Europe • An Undergraduate Program Designed For Lifelong Learning • An Approach To Public Works Continuing Education • A Joint Videotaped Trainin Program	
				4C	INDUSTRY/GOVERNMENT PROGRAMS • An Individualized Instruction Approach to Continuing Education for Engineers by Industry • Bridging The Academic-Industrial Gap General Electrics Entry-Level Process • Continuous Education in Agricultural Programs • Continuing Education at Siemens	6C	GROUP III • Power Engineering Programs In The USSR • A Program for Control Education And Training In Large Industrial Complexes • Energy Use And The Role Of Continuing Education • Self Development in Agriculture Through Lifelong Learning	
10:00-10:30		COFFEE BREAK (11:00 - 11:30)		COFFEE BREAK		COFFEE BREAK		10:00-10:30
10:30-12:30 P.M.		1A	CONTINUATION OF SESSION 1 ABOVE PANEL DISCUSSION	4A 4B 4C	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)	6A 6B 6C	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)	10:30-12:30 P.M.
12:30 - 2:30		LUNCH (1:00 - 2:30)		LUNCH		LUNCH		12:30 - 2:30
2:30 - 3:30 P.M.	WELCOME TO THE CONFERENCE	2	• MOTIVATION IN ADULT EDUCATION	5A	Methods of Need Analysis Continuing Education Programs	7	• THE FRENCH CONTINUING EDUCATION LAW • DEVELOPING A NATIONAL NEED ANALYSIS	2:30 - 3:30 P.M.
				5B	Promotion Techniques For Continuing Education Programs			
				5C	Costs Associated With Continuing Education Programs			
				5D	Staffing Requirements For Continuing Education Programs			
				5E	Evaluation of Continuing Education Programs			
3:30 - 4:00		COFFEE BREAK (4:00 - 4:30)		COFFEE BREAK				3:30 - 4:00
4:00 - 6:00 P.M.		3	• GOVERNMENT'S INFLUENCE ON CONTINUING EDUCATION	5A 5B 5C 5D 5E	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)		PANEL DISCUSSION	4:00 -6:00 P.M.
7:00 - 8:00 P.M.			WELCOME RECEPTION		ON YOUR OWN IN MEXICO CITY			7:00 - 8:00 P.M.
8:00 - ? P.M.							RECEPTION AND BANQUET PALACIO DE MINERIA	8:00 - ? P.M.

Pyramid of the Sun
Teotihuacan



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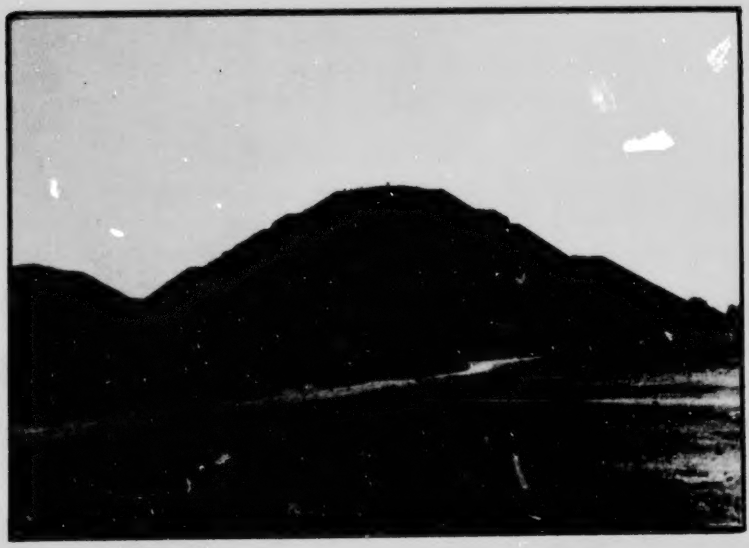

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FOREWORD

Lawrence P. Grayson
National Institute of Education
Washington, D.C.

Joseph M. Biedenbach
Director, Continuing Education for Engineering
University of South Carolina
Columbia, South Carolina

We are delighted to be able to publish these PROCEEDINGS of the First World Conference on Continuing Education, and to have them available at the opening of the meeting. This conference is a major event, as it is the first time that several hundred people with speakers from 28 countries on five continents have gathered at a professional, rather than a governmental, meeting to discuss the topic of continuing education for engineers. This theme is important to engineers in every country, since the rapid advances in technology and the changing needs of each nation require engineers to continue to update their knowledge so that they can best serve their countries, themselves and their fellow men.

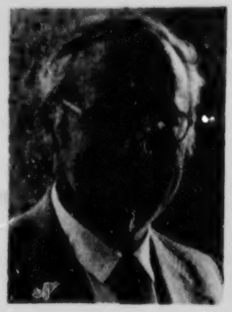
The Conference also is significant because of the cooperation exhibited by the participating organizations. The meeting is sponsored by the University of Mexico, the American Society for Engineering Education (ASEE) through its International Division and its Continuing Professional Development Division, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Pan American Health Organization (PAHO), the Pan American Union of Engineers Association (UPADI), and the Secretariat of Human Settlement and Public Works of Mexico (SAHOP). Their involvement has helped assure that the intersts and needs of many nations are being addressed, and that the results of the Conference will be made known to those persons throughout the world who can benefit from them.

The PROCEEDINGS are meant to serve several purposes. First, they contain all of the papers that the speakers will present. Since the full documents are available to every participant at the time of presentation, the speakers will not have to give the details of their work, but can use their time to discuss the major points in their papers and engage in a dialog with the audience. Further, additional papers are contained in the PROCEEDINGS that are to be used to give a fuller set of ideas on a given topic and to provide a basis for discussions with their authors. Although the PROCEEDINGS is a working document of the meeting, it also is an historical record of the Conference, both for the people who attend and for persons who cannot come to Mexico City at this time, but who are interested and involved in the continuing education of engineers.

In order to make this document of increased value to the readers, and to help those who attend the Conference, we have included photographs, biographical information and addresses for all of the authors, session chairmen and key persons involved in organizing the meeting, so that they may be recognized during the Conference or contacted at a later time.

We hope that the PROCEEDINGS satisfies its purposes and meets the needs of the Conference attendees and of those interested in reading the papers that have been presented. We further hope that this conference is highly successful, so that it may be followed by future professional meetings of engineering educators from many nations, not only to discuss continuing education, but also other topics of importance to the field. Through mutual understanding and discussion of each others problems, we can all benefit.

We owe a special debt of gratitude to the University of Mexico and to its representatives for serving as host for this Conference.

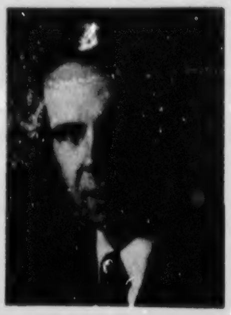


Lawrence P. Grayson

and

Joseph M. Biedenbach

April 25, 1979



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April 25-27, 1979 .... Mexico City

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This first world conference represents an effort to bring together the best talent available from all over the world to bear on the problems of continuing engineering education. We caution the readers of this proceedings to keep in mind the different social systems under which these programs exist and glean out those factors which you can translate into your system.

This publication is a collection of papers that have been presented at the First World Conference on Continuing Engineering Education. Some are missing. The complexities of translation, mailing time, government and organization approval, and a host of other problems did not allow a complete preprint of the conference. The various case studies can be used to further understand the variation in needs, costs and evaluation from one country to another. The richness of information can only be fully understood after very careful reading.

I want to thank each author and their sponsoring organizations for their contribution. More particularly, I want to thank the local organizing committee and the Mexican government for their part in this time consuming effort and to Joe Biedenbach and Larry Grayson for their editorial work. The planning committee also appreciates the very wide support of the co-sponsors and financial contributions.

John P Klus

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5C	COSTS ASSOCIATED WITH CONTINUING EDUCATION PROGRAMS	THURSDAY PM
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5E	EVALUATION OF CONTINUING EDUCATION PROGRAMS	THURSDAY PM
6A	GROUP I DISCUSSION GROUP	FRIDAY AM
6B	GROUP II DISCUSSION GROUP	FRIDAY AM
6C	GROUP III DISCUSSION GROUP	FRIDAY AM
7	FRENCH CONTINUING EDUCATION LAW	FRIDAY PM
	DEVELOPING NATIONAL NEED ANALYSIS	FRIDAY PM

INAUGURATION OF CONFERENCE AND EXHIBIT

Dr. Guillermo Soberon Acevedo
Rector
Universidad Nacional Autonoma
de Mexico
Mexico City

GUILLERMO SOBERON - ACEVEDO

GUILLERMO SOBERON - ACEVEDO, Medical Doctor University of Mexico 1949; Doctor of Physiological Chemistry, University of Wisconsin, 1956; Intern Hospital de Enfermedades de la Nutrición 1949-50; Resident Internal Medicine Instituto Nacional de la Nutrición, 1950-1952; Head Department of Biochemistry, Instituto Nacional de la Nutrición 1956-1965. Director of the Institute of Biomedical Research 1965-1971; Principal Investigator, IIB 1965-, Professor School of Medicine 1958; Coordinator of Sciences, University of Mexico 1971-1973; Rector University of Mexico 1973- . Recipient Sourasky Sciences Award (Fondo de Fomento Educativo, 1968; Elizondo Sciences Award (Fundación Elizondo 1974; Societies: Academia Nacional de Medicina, Mex. (President 1974-75); (Academy Award 1965); Academia de la Investigación Científica (Science Award of the Academia 1965); American Society of Biological Chemists; The New York Academy of Sciences; The Biochemical Society; American Chemical Society; Unión de Universidades de América Latina (UDUAL) (President 1976 to date). 42 original papers published; 74 formal communications presented in different congresses and symposia in Mexico and other countries; 88 formal lectures given at different institutions and scientific societies in Mexico and other countries.

CHRONOLOGICAL HISTORY OF THE UNIVERSITY OF MEXICO

Al sur del Distrito Federal, capital de la República Mexicana, en un área de 7.3 millones de metros cuadrados, se localizan las principales instalaciones de la Ciudad Universitaria, sede de la Universidad Nacional Autónoma de México, fundada en el año de 1551 por Cédula Real del Rey Felipe II; y por Bula de Paulo IV y Clemente VII de 1555 y 1595, respectivamente.

En 1536, a petición del Virrey de la Nueva España, D. Antonio de Mendoza, y por intermedio del Obispo de Méjico, Fr. Juan de Zumárraga, el Emperador Carlos V inicia los estudios para la erección y creación de una Universidad en el Nuevo Continente. Su sucesor, Felipe II, ordena, el 30 de abril de 1547, la erección de la Real y Pontificia Universidad de Méjico. En ella habrían de impartirse, entre otras, cátedras de Grámatica, Artes, Teología y Retórica y Sagrada Escritura. Los grados universitarios eran Bachiller, Licenciado o Maestro y Doctor.

Durante tres siglos, la Real y Pontificia Universidad fue el centro más distinguido de la vida intelectual de la Colonia.

Este fructífero periodo termina con la iniciación de la lucha de Independencia en septiembre de 1810.

Durante los 222 años de su existencia, había graduado 29,882 Bachilleres, 277 licenciados y 1403 doctores en Teología, cánones, Leyes, Medicina y Artes. De la-

In the southern part of the Federal District, capital of Mexico, on an extension of 7.3 million square meters, are the main buildings and facilities of the University City, seat of the National Autonomous University of Mexico, founded in 1551 by a Royal Schedule of King Phillip II and papl bulls, one issued in 1555 by Paul IV and another by Pope Clement VII in 1595.

In 1536, at the request of the Viceroy of New Spain, Don Antonio de Mendoza, and through the offices of the Bishop of Mexico, Fr. Juan de Zumarraga, Emperor Charles V began studies to erect and create a University on the New Continent. His successor, Phillip II, on the 30th of April, 1547, ordered the erection of the Royal Pontificial University of Mexico. Among other subjects taught at the University were the chairs of Grammar, Art, Theology, Rhetoric, and Holy Scripture. The University offered the degrees of Bachelor, Licenciate, Master and Doctor.

For three centuries the Royal Pontificial University was the most distinguished center of intellectual life in the Colony. This fruitful period came to an end when the War of Independence began in September of 1810.

Universidad habían egresado 84 obispos y arzobispos, miembros de las Reales Audiencias, de los Supremos Consejos de Castilla o Indias, prebendados, canónigos y dignidades para las Catedrales; inquisidores, consultores y calificadores del Santo Oficio; y catedráticos para las Universidades de América y de Europa (Salamanca, Alcalá, Sevilla, Valladolid y Granada).

Durante el siglo XIX, la Universidad fue el escenario de las luchas políticas que aquejaban al país.

Desde septiembre de 1810 hasta la caída del Emperador Maximiliano en 1867, la Universidad se vió en grave peligro.

Aún durante las épocas de Gómez Farías (vicepresidente durante el Gobierno de D. Antonio López de Santa Anna), quien en 1833 ordena clausurar la Universidad, así como bajo la esporádica reapertura bajo los gobiernos de Comonfort (1857) y Zuloaga (1858), la Universidad, como tal, no dejó de funcionar.

Se suspendían algunas cátedras, perdía sólo el nombre, desaparecían los rectores, pero seguía subsistiendo en sus escuelas de Derecho, de Medicina y en los colegios máximos de San Pedro y San Pablo, San Gregorio y San Juan de Letrán.

Así pues, la Universidad, gracias a la pervivencia de esos planteles, había tenido una existencia continua desde el siglo XVI hasta el XIX.

Los decretos de clausura la desmembraron, substituyendo el gobierno de su rector y su claustro por un burócrata, jefe de una sección del Ministerio de Justicia y Negocios Eclesiásticos, hasta que Don Justo Sierra, el 26 de mayo de 1910, por iniciativa presentada y aprobada por el H. Congreso, logra reunir a los miembros dispersos, da unidad a la Institución y categoría oficial a la Universidad. Entre las Escuelas que se incorporan, está la de In

In its 222 years of existence it turned out 29,882 Bachelors, 277 Licenciates, and 1403 Doctors of Theology, Canon Law, Law, Medicine and Art. From this University came 84 bishops and archbishops, members of the Royal Audience, of the Supreme Councils of Castile and the Indies, prebendates, canons, dignitaries for Cathedrals, inquisitors, consultants, and judges of the Holy Office and teachers who held chairs in the Universities of America and Europe - Salamanca, Alcala, Sevilla, Valladolid and Granada.

During the XIX Century the University was the scene of political struggles that tore through the country.

From September, 1810, until the fall of Emperor Maximilian in 1867, the University was in serious danger, but even in times of Gomez Farias (Vice President during the administration of Don Antonio Lopez de Santa Anna) who ordered the University closed in 1833, and during its sporadic reopenings during the administrations of Comonfort (1857) and Zuloaga (1858), the University never ceased to function as such.

Some chairs were suspended, the name was lost, rectors vanished, but it continued to survive in the Schools of Law, Medicine and the Maximum Colleges of St. Peter and Paul, St. Gregory and St. John Lateran.

Thus, the University, thanks to the persistence of these schools, can boast an uninterrupted existence from the Sixteenth through the Nineteenth Centuries.

It was dismembered by a decree that closed it, and its administration passed from the hands of a Rector and his cloister to those of a

genieros que existe desde 1867, a partir de la Ley de Instrucción Pública de Don Benito Juárez y que tiene como antecedente el Seminario de Minas que nace de la Cédula Real de 1792.

El 11 de julio de 1929, el presidente D. Emilio Portes Gil, otorga a la universidad su Autonomía, durante la gestión rectoral del Lic. Ignacio García Téllez. A partir de esta fecha, y hasta nuestros días, la Universidad toma su nombre de UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO. El 30 de diciembre de 1944, se instituye la Ley Orgánica de la UNAM, la cual establece, en su artículo primero, que las funciones de nuestra Máxima Casa de Estudios, están encaminadas a la docencia, la investigación y la difusión de la cultura en el ámbito nacional.

Actualmente la Universidad cuenta (1979) con 9 mil quinientos millones de pesos en su presupuesto para atender las necesidades de alrededor de 300,000 alumnos (enseñanza media superior, licenciatura y posgrado); el pago de los sueldos de 20,000 maestros (técnicos académicos incluidos); 1,753 investigadores; y 17,500 empleados administrativos.

Los estudios a nivel profesional se realizan en las Facultades y Escuelas de la UNAM, tanto las ubicadas en la Ciudad Universitaria como en la Periferia del Distrito Federal (Escuela Nacional de Música, Escuela Nacional de Enfermería y Obstetricia, planteles de Escuelas Nacionales de Estudios Profesionales -ENEP Cuautitlán, Iztacala, Acatlán, Aragón y Zaragoza-).

En la Facultad de Ingeniería que cuenta ahora con 1,000 maestros y atiende a 10,500 alumnos de licenciatura y a 600 en el posgrado, se ubica el Centro de Educación Continua (CEC), extensión académica para cursos de regularización y actualización de conocimientos profesionales a ni-

bureaucrat, head of a department in the Ministry of Justice and Ecclesiastical Affairs, until Don Justo Sierra, in pursuance of a bill proposed and adopted by Congress on May 26, 1910, managed to recall its scattered members and gave unity to the Institution and official standing to the University. Among the schools that were incorporated were the School of Engineers, which exists since 1867 when the Public Instruction Act of President Benito Juarez was enacted and which is an outgrowth of the Mining Seminary, created by a Royal Schedule of 1792.

On July 11, 1929, President Don Emilio Portes Gil granted its autonomy to the University, during the Rectorship of Ignacio Garcia Tellez. Since then the University bears the name of NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO. On December 30, 1944, the UNAM Organic Law was instituted which in its First Article specifies that the functions of our First House of Learning shall be directed to teaching, research and the dissemination of culture throughout the country.

At present (1979), the University has a budget of 9.5 billion pesos to cater to the needs of some 300,000 students (upper middle education, licenciate and post-graduate programs) and to pay the salary of 20,000 teachers (including academic technicians), 1,753 researchers and 17,500 administrative employees.

Professional training is provided in the various UNAM schools, both those located in the University City and in other peripheral facilities such as the National Music School, the National School of Nursing and Obstetrics and the National Schools of Professional Studies - ENEP - in

vel especialización, creado en julio de 1971, con el fin de estudiar, desarrollar e implantar los métodos más adecuados de educación continua para la actualización de conocimientos, enfocados, primordialmente, a aquellos profesionistas que deseen estar al tanto de los avances de la Ingeniería.

Así, la Universidad Nacional Autónoma de México, mediante el esfuerzo, el valor, el empeño y la dedicación de quienes han integrado la Institución -rectores, investigadores, catedráticos, alumnos, empleados-, quienes han visto como principal objeto el bien de ella, y a través suyo el de México, responde de una manera cabal, al lema que D. José Vasconcelos concibiera para nuestra Máxima Casa de Estudios:

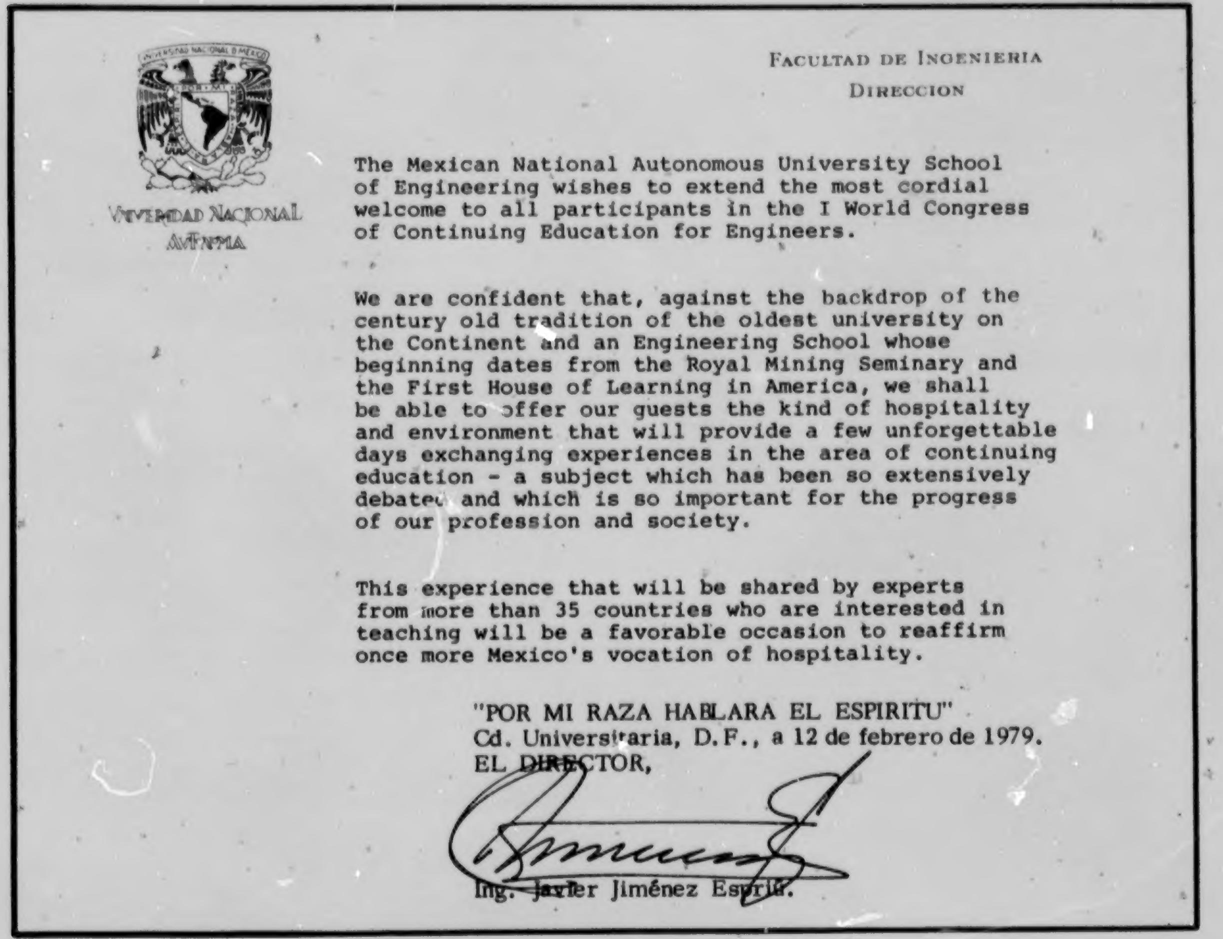
"POR MI RAZA HABLARA EL ESPIRITU"

Cuautilan, Iztacala, Acatlan, Aragon and Zaragoza (in the periphery of Mexico City).

The Engineering School now has 1000 teachers and 10,500 undergraduates and 600 students in its postgraduate program. The Continuing Education Center is located in this School as an Academic extension for updating and specialized professional earning. It was created in July, 1971, with the purpose of studying, developing and implementing the most appropriate methods of continuing education to update learning, addressed primarily to professionals who want to keep abreast of the latest developments in Engineering. In this way the National Autonomous University of Mexico, thanks to the effort, courage and dedication of those who make up the institution rectors, researchers, teachers, students and employees - whose main object has been its good, and through it, the good of Mexico, has fully lived up to the motto devised by Don Jose Vasconcelos for our Greatest House of Learning "THE SPIRIT SHALL SPEAK THROUGH MY PEOPLE"

SESSION 1

Prof. Javier Jimenez-Espriu
Dean of Engineering
University of Mexico
Mexico City



VNIVERSIDAD NACIONAL
AVTONOMA

FACULTAD DE INGENIERIA
DIRECCION

The Mexican National Autonomous University School of Engineering wishes to extend the most cordial welcome to all participants in the I World Congress of Continuing Education for Engineers.

We are confident that, against the backdrop of the century old tradition of the oldest university on the Continent and an Engineering School whose beginning dates from the Royal Mining Seminary and the First House of Learning in America, we shall be able to offer our guests the kind of hospitality and environment that will provide a few unforgettable days exchanging experiences in the area of continuing education - a subject which has been so extensively debated and which is so important for the progress of our profession and society.

This experience that will be shared by experts from more than 35 countries who are interested in teaching will be a favorable occasion to reaffirm once more Mexico's vocation of hospitality.

"POR MI RAZA HABLARA EL ESPIRITU"
Cd. Universitaria, D.F., a 12 de febrero de 1979.
EL DIRECTOR,

Ing. Javier Jiménez Espriú.

THE SUPER INDUSTRIAL REVOLUTION

Alvin Toffler
Author
Future Shock

"Despite appearances, the U.S. is entering the most revolutionary period in its history. Our political system and educational structures are racing toward absolescence, and very little fresh thinking is being done about how to save or replace them." So says Alvin Toffler, author of Future Shock, one of the most important most talked-about books of the decade.

Returning from extensive research and speaking tours. Mr Toffler warns that "in the next 25 years all of us will be required to deal with more change than we have ever had to handle-- changes in our life styles, our politics, our schools, churches and families. The last election and a relative calm on the campus ought not to deceive us; unles we learn new strategies for coping, many of us will fall victim to adaptational breakdown."

Future Shock, which won the Prix du Meilleur Livre Etranger in France, and the McKinsey Foundation Book Award in the U.S., has been published in some 50 countries, and has been hailed for its breakthrough thinking and its passionate and lucid style. According to C. P. Snow, "No one ought to have the nerve to pontificate on our present worries without reading it." Betty Friedan has called it "Brilliant and true." The Wall Street Journal termed it "Explosive." And Le Figaro's reviewer in Paris declared it, "The best study of our times that I know...Of all the books I have read in the last 20 years, it is by far the one that has taught me the most."

An earlier work by Toffler, The Culture Consumers, and a recent collection he edited, Learning for Tomorrow, have also drawn enthusiastic praise.

Like his books, Mr. Toffler's lectures are the result of extensive interviews with Prime Ministers and Nobel Prize winners as well as students, radicals, businessmen, educators, and housewives. They are tightly organized and well presented.

A former Associate Editor of Fortune magazine and a contributor to scholarly journals as well as such popular publications as Saturday Review, Playboy and Readers Digest, Mr. Toffler describes himself as a "social critic" and "futurist." As such, he has served as consultant to the Institute for the Future, the American Telephone and Telegraph Company, the Rockefeller Brothers Fund, and many other leading corporations and organizations. He served as Visiting Scholar at the Russell Sage Foundation and a former Visiting Professor at Cornell University.

Mr. Toffler is now at work on another book dealing with personal and political change.

SESSION 1A

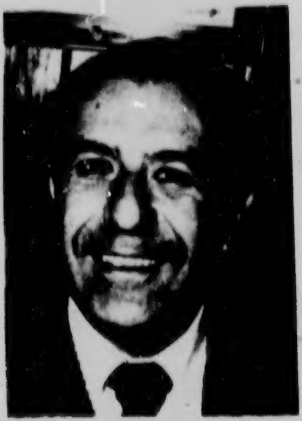
DISCUSSION AND RESPONSE TO THE SUPER INDUSTRIAL REVOLUTION

Prof. Javier Jimenez-Espriu
Dean of Engineering
University of Mexico
Mexico City

Myron Tribus
Director, Center for Advanced
Engineering Study
Massachusetts Institute of Technology
Cambridge, Massachusetts

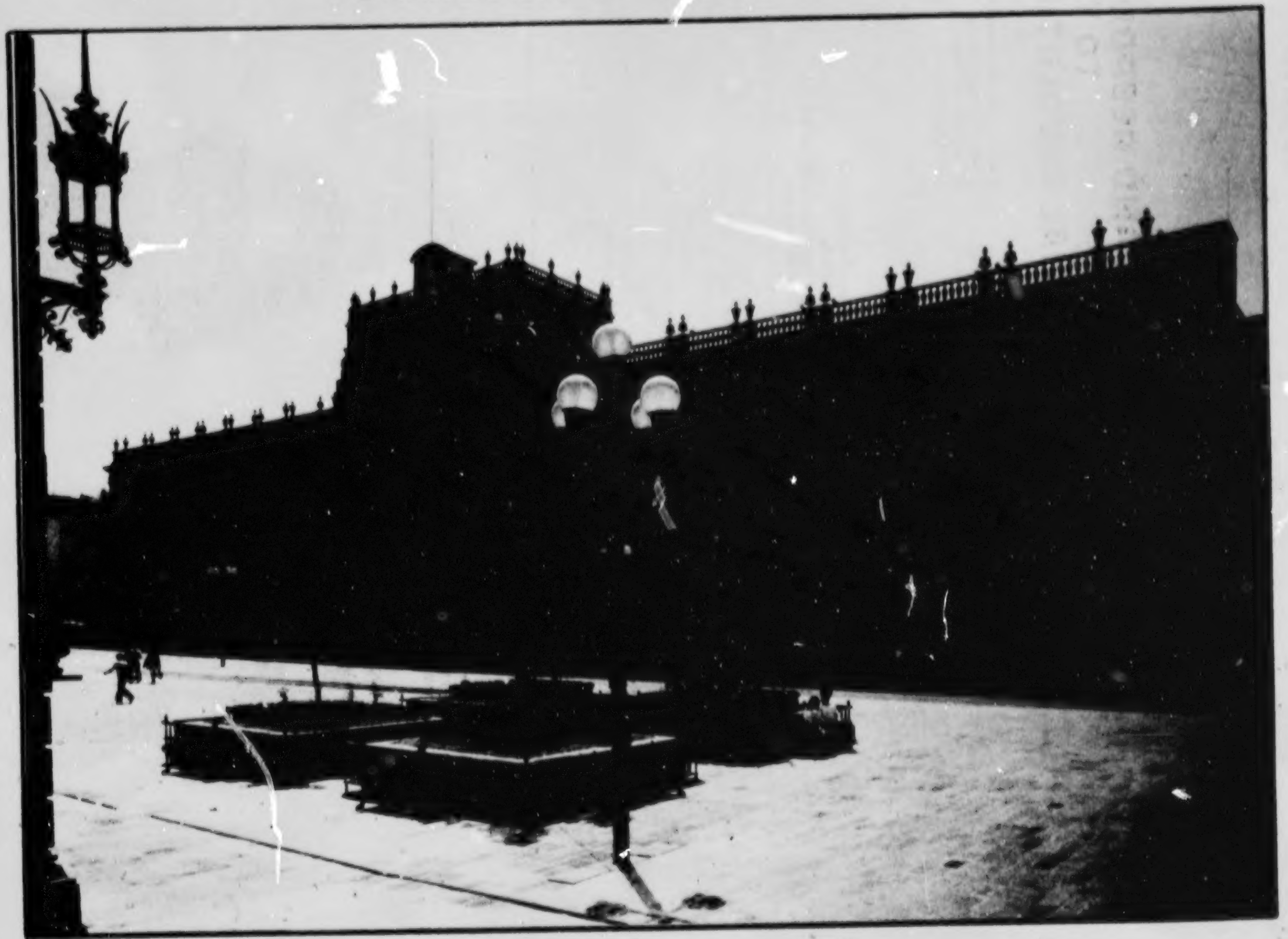
Before M.I.T., Dr. Myron Tribus was a Senior Vice President for the Xerox Corporation, U.S. Assistant Secretary of Commerce for Science and Technology, Dean of the Thayer School of Engineering at Dartmouth College, Professor of Engineering at U.C.L.A. and a Captain in the U.S.A.F. He has published books and papers on heat transfer, thermodynamics, decision theory and design. The Center for Advanced Engineering Study reaches approximately 12,000 engineers worldwide with its programs of continuing education.

Paul Ortiz Ortiz
University of Mexico
Mexico City



Dr. Pierre LeGoff
Institut Polytechnique National
France

SCENES FROM MEXICO



Palace of Mining
School of Mining Engineering until 1945. Now, the Graduate School of Engineering.

THE ROLE OF MOTIVATION IN ADULT EDUCATION

Professor Alfonso Henriquez DeBrito
Cidade Universitaria
Brazil

Motivation In Continuing Education Activities

When one discusses the concept of motivation in continuing education activities, three distinct groups must be considered. They are the engineer who participates in the program, the business or industry who pays the bill and the institution that plans organizes, develops, and provides the program. Throughout these proceedings, there are many different views for the reasons that business and industry, educational institutions, professional societies, and entrapreneurs are motivated to participate in this growing educational activity on a worldwide basis.

One common thread can be seen in these brief discussions of a very complex topic: Each of these groups feels that their particular needs can be served by active involvement in this activity. What follows is a brief discussion of some of the reasons each group is active.

The Engineer

Engineers who have been out of school and involved in the practice of engineering for some time feel they can best be served by short, concentrated study in a newer technological developments not available during their undergraduate and graduate educational programs. In particular they are concernced with:

- A respite from the job, an opportunity to meet professional colleagues in other environments, and general self revitalization.
- A need to learn new skills for job mobility, promotion, and overall career development.
- A need to assure themselves that they can compete with recent graduates in learning new techniques for product development and improvement.
- Broadening their horizons and effectiveness in problem definition and solution.
- Assisting younger graduates become proficient in the new technology in their area of speciality.

Business and Industry

Industry's interest in having their engineers participate in continuing education activities is usually motivated because of the inherent belief that further education will increase their employees' productivity. They are motivated to send people to programs if they are convinced some of the following results will accrue:

- The instruction will be cost and time effective for the individuals who will be trained.
- A new skill can be developed that is needed to increase the productivity of the engineer.
- A minimum time away from the job is assured.
- The instruction is clearly targeted at conveying specifically necessary information to the participants.
- A strongly perceived need exists in the company for this kind of information.
- The information presented will satisfy a required government regulation.

The Professional Societies

Professional societies are motivated to offer continuing education activities to their members and to the profession in general because:

- It is a necessary service to their members
- Continuing education programs are excellent supplements to their existing extensive publication activities.
- Their responsibility of maintaining a professional workshop in their specialty and the setting of standards in the profession mandates that their members be qualified in the speciality area.
- Their organizational structure, with sections, local chapters, etc. is well developed and suited to organizing continuing education activities for a widely geographically dispersed group of professionals.

Educational Institutions

Educational institutions, both public and private, have as one of their goals the dissemination of knowledge to the publics they serve. With a long history of educating undergraduate and graduate engineering students it is logical that they are beginning to be more motivated to undertake the continuing education of engineering graduates. They are motivated for the following reasons:

- To be of educational service to the individual engineer and to the industries they are able to serve.
- To better utilize their capital investment in their physical plant.
- To respond to industries' needs for better trained enployees.
- To enhance their image with government - legislative committees, and business and industry in general.
- Education is their priority mission in our society; continuing education is rapidly assuming a more important position in the academic hierarchy.

Private Entrepreneurs

Since the time that the demand for continuing education studies has increased, along with attendance, profit making corporations have been formed to provide an educational service in special, well-defined, and profitable educative activities. Their motivation to offer programs includes some of the following:

- To make a profit.
- Because many of their staff have industrial experience they are in a very good position to determine the actual educational needs of engineers working in industry.
- Because of their limited objectives they need only serve those areas of continuing education where there exists the probability of a high return on investment.
- Their organizational structure is usually sufficiently flexible to provide rapidly a a specific program for a specific need, particularly for industry. At present, this flexibility is not characteristic of most higher academic institutions.

Motivation, whether individual or institutional, is a complex subject at best. It is hoped that participants in this conference will gain additional insights into this subject. If the continuing education activity in each institution expects to grow over the next decade, much more must be learned concerning individual and institutional motivation to increase participation in continuing engineering education activities.

LA MOTIVATION DANS L'EDUCATION DES ADULTES

Dr. Bertrand Schwartz
Distinguished Professor
University of Paris
Paris, France

De très nombreux livres et articles ont été publiés ces dernières années sur l'Education des Adultes. En écrire, en quelques pages seulement "un de plus", qui, bien sûr, ne doit être ni banal ni trop théorique, ni uniquement énoncé d'anecdotes ou de recettes, est d'une insurmontable difficulté. S'y ajoutent deux difficultés personnelles :

tout d'abord j'ai eu, avec mon ex-collaboratrice Anne de Blignières, en 1978, à rédiger, au nom d'un groupe d'experts du Conseil de l'Europe, à partir de 25 études d'expériences ou de projets un rapport[1] sur le Concept d'Education Permanente. Comment inventerais-je de nouvelles idées depuis un an ? et sinon, comment ne pas me répéter ?

. d'autre part, mes activités m'ont depuis plusieurs années, beaucoup plus porté vers la formation de personnes de faible niveau de scolarisation que vers celle des ingénieurs. Mon discours et mes exemples se référeront donc peu aux ingénieurs, mais j'espère que les lecteurs seront d'accord avec moi pour reconnaître que, si différence il y a, bien des principes sont semblables. Et ce peut être là un thème de réflexion.

La solution que j'ai adoptée consiste à reprendre les idées-forces du rapport du Conseil de l'Europe et à les éclairer par deux exemples, non tirés du rapport, que je ne décrirai évidemment que très brièvement, pour terminer par un retour à quelques réflexions théoriques.

Un des premiers constats que j'avais fait, en tant qu'éducateur d'adultes, qui n'a d'ailleurs rien d'original, est que l'adulte n'est prêt à se former que s'il espère trouver dans sa formation une réponse à ses problèmes dans sa situation, que s'il a conscience d'une possibilité de changement, d'un changement auquel il participera, et qu'il peut alors lier sa formation à ce changement. Le besoin de formation n'est pas un besoin primaire, il est inculqué, acculturé, lié à la situation sociale de la personne. Ce constat m'a amené à "questionner" les 25 expériences à partir de deux principes liés entre eux , la responsabilisation du formé, la globalisation de la formation, conditions nécessaires pour permettre au formé de "mobiliser son potentiel en assurant sa propre unité"[1].

I - Quelques réflexions théoriques

A propos de la responsabilisation

Comme l'a souligné le rapport, malgré la générosité des idées énoncées avec force par de nombreux décideurs, la participation de l'adulte aux décisions concernant sa formation reste généralement très restreinte, sinon nulle (un seul choix est possible au stagiaire : suivre le cours ou quitter lorsqu'il en a assez). Il n'y a guère que dans certaines actions dites "d'éducation populaire" ou dans les formations au sein d'associations, que les personnes dans le groupe et/ou le groupe ont un véritable pouvoir sur la définition des objectifs, le choix des méthodes et l'évaluation. Cependant, dans la mesure où l'on admet l'hypothèse du lien éducation-changement, du lien éducation-action sur l'environnement, "celle-ci tenant toute dans le non-isolement, dans l'appartenance à une collectivité"[1] l'action collective prend toute sa force.

Le rapport étudie surtout l'action collective de type développement communautaire, en partant de l'exemple de l'ACUCES [2] ; ainsi :

"Une action collective est tout d'abord une action conçue à l'intention d'une collectivité spécifique, une action de masse, qui, parce que l'on attend de développer un processus social de formation, responsabilise une multitude d'acteurs sociaux. Pour ce faire , elle organise une concertation permanente des représentants élus, une analyse constante et répétée de l'expression des besoins par l'analyse de situations. En cela, elle veut renverser le rôle de l'offre qui devient réponse aux besoins exprimés.

"La participation-prise de responsabilité se situe à deux niveaux : le "groupe en formation" d'abord, mais surtout la collectivité tout entière. Et là tient toute la différence avec les actions "individuelles".

"L'organisme intervient pour animer, mais son but est de rendre les interessés autonomes au point d'assurer leur propre prise en charge ; s'il organise l'expression des besoins, il le fait faire par des représentants de la "population", qui siègent au sein d'un comité spécialement créé à cet effet ; s'il participe à la gestion quotidienne c'est en éclairant l'instance politique qu'est le comité ;

"les objectifs sont collectifs : la formation méthodologique des groupes importe autant que l'acquisition individuelle des savoirs ;

"les formateurs sont issus de la collectivité, choisis par elle ; l'action collective au lieu de se limiter aux traditionnels "experts", fait appel à toutes les "personnes-ressources" possibles".[1]

A propos de la globalisation

Le rapport pose la question du pourquoi des savoirs, distinguant les savoirs-connaissances, des savoir-pouvoir agir, la globalité se déterminant à un triple niveau qui éclaire très bien cette distinction :

"- l'amorce éducative : y a-t-il demande éducative, et dans l'affirmative, de qui émane-t-elle ? d'individus que l'on "regroupe", d'un ou plusieurs groupes, d'une collectivité, d'une région ?
"- la situation de formation : la formation et ses axes privilégiés se définit-elle autour de l'"éducatif" ou du "non-éducatif" ?
"- l'issue éducative : le mode de retour au quotidien qui, s'il veut être action sur l'environnement, ne peut rester individuel, et doit devenir "collectif". [1]

II - Quelques applications pratiques - Deux exemples d'actions collectives dans des "organisations hiérarchiques" (une entreprise privée, une administration publique).

J'utilise ces deux exemples, pour me rapprocher des problèmes étudiés à ce colloque, ceux des ingénieurs et des cadres. Si ceux-ci, en effet sont évidemment "membres" comme tout un chacun, de nombreuses collectivités (leur cité, une maison de la culture),en tant qu'ingénieurs ils n'en constituent une que par le biais de l'entreprise ou de l'administration dans laquelle ils travaillent. Les ingénieurs et les cadres d'une entreprise forment un"collectif". Là et là seulement, la globalité de la situation éducative se retrouvera pour eux aux trois niveaux : de l'amorce éducative (par la façon même dont peut être organisée l'analyse des demandes), dans la situation de formation (par la participation aux formations organisées), et dans l'issue éducative (par la possibilité de valorisation collective quotidienne de ce qui aura été appris).

Exemple 1 - Formation à la statistique des ingénieurs d'une grande entreprise [3]. L'entreprise comprend quelques dizaines d'usines réparties sur tout le territoire français. Dans chaque usine, quelques ingénieurs. Le Directeur Général, très convaincu de la nécessité d'une formation continue de ses cadres, choisit de faire enseigner la statistique, estimant qu'il s'agit là d'un contenu particulièrement intéressant dans la mesure où il correspond, selon lui, à un besoin à la fois professionnel et culturel ; elle est aussi nécessaire à la bonne marche de la production qu'à la compréhension de nombreux problèmes de l'environnement. Il veut alors permettre à tous les cadres de se former.

La démarche employée est la suivante : 7 ingénieurs, 1 par région, déjà formés à la statistique travaillent ensemble pendant une année à produire un"nouveau contenu". Partant en effet d'un cours existant, ils tentent "d'appliquer" [4] toutes les théories qu'ils réapprennent ainsi, et rédigent un document qui, pour n'être que le premier livre enrichi de nouveaux exemples, en est en fait très différent.

Puis dans sa région chacun de ces 7 ingénieurs devient formateur de collègues volontaires qui, cette fois-ci, "apprennent" les théories statistiques (car eux ne les avaient pas encore apprises) réfléchissent sur les exemples qui leurs sont proposés, et en cherchent d'autres à leur tour.

La troisième phase démarre par une série d'interviews menés auprès des cadres qui n'ont pas encore été volontaires. Ils le deviennent, presque tous convaincus d'une faiblesse devenue maintenant claire et avouable. Mais ils ne sont pas les seuls à réclamer de la formation. Les Directeurs, qui ne comprennent plus les rapports qui leur sont remis en veulent aussi. Et les contremaîtres, responsables des mesures qui alimentent les études statistiques, demandent à leur tour à comprendre.

La troisième année voit une réponse massive à ces différentes demandes, et ce sont les ingénieurs formés qui, avec l'aide des premiers formateurs forment leurs collègues ou les Directeurs et les contremaîtres.

La quatrième année dessine une nouvelle orientation. Les cadres administratifs veulent, comme les autres, "leur formation", mais les contenus sont définis avec eux et se diversifient : c'est l'emploi de l'ordinateur qui commande une réflexion-formation collective sur le sens de cette technologie ; ce sont les nouvelles techniques de gestion qui induisent des demandes en formation économique. Ainsi bientôt, presque tous les cadres sont en formation, et le nombre de ceux qui, en dehors de l'entreprise, recherchent une formation personnelle, est en nette augmentation.

L'intérêt de cette expérience a été considérable, car elle a été une des premières actions collectives. Certes, il n'y avait pas de comité. Certes, au début au moins, l'amorce éducative a été le fait du seul Directeur Général. Mais la situation de formation a bien été co-gérée par les groupes eux-mêmes ; mais l'issue éducative a été immédiatement branchée sur la vie quotidienne. Et peu à peu les choses ont changé ; l'amorce éducative est devenue le fait des ingénieurs eux-mêmes (même s'il y a toujours eu "négociation" avec la Direction, négociation mais jamais refus) et un comité a bien été désigné, où siègent aux côtés de la Direction, des représentants des ingénieurs. La quasi-totalité des cadres a donc été impliquée dans cette action : est-ce parce qu'ils se sont sentis "forcés" ? peut-être ; mais, disons qu'il s'agissait d'une pression "intérieure", non d'une "menace" venant de la hiérarchie. Je crois qu'on peut honnêtement affirmer que les cadres se sont beaucoup formés et en ont été satisfaits. Leur motivation a été, dans l'ensemble, très élevée, incomparablement plus que dans les entreprises où la Direction se contente d'offrir des cours sur catalogues.

Education-intégration ? Comment le nier ? Mais éducation, après tout, dans la mesure où elle a donné -les formés l'ont très souvent souligné- des moyens de "se défendre" contre l'arbitraire.

Exemple 2 - La formation du personnel d'une Préfecture Française

Une préfecture est une institution publique qui comprend à peu près 500 personnes ; elle constitue le "rouage" exécutif entre les différents ministères et la région. Elle est donc en rapport avec tous les ministères, et transmet, à toutes sortes de publics, les ordres et les instructions ministériels. Elle est dirigée par un Préfet nommé par le Gouvernement.

Les Préfectures recevant presque chaque jour des missions socio-économiques nouvelles et difficiles (il y a de plus en plus de textes de lois complexes, et des évolutions socio-économiques importantes), les personnels ne sont finalement plus adaptés, plus préparés à leurs nouveaux rôles.

Pour essayer de répondre à ces besoins nouveaux, le Ministère commence d'abord par offrir des formations traditionnelles, en"ouvrant"des cours. Il constate vite que ceux -ci sont très peu efficaces, non parce que les formés n'y vont pas (ils y sont obligés) mais, n'étant pas en état de faire le moindre lien entre ce qu'ils ont à apprendre et leur réalité, ils n'apprennent rien. Les "bonnes raisons" pour ne pas se former deviennent si nombreuses que le Ministère doit abandonner les actions de formation.

Une commission créée pour étudier ce problème décide de "lancer" une action collective. Le choix du lieu d'expérimentation se fait sur le critère de changement. Une Préfecture en a trois en perspective : délégation de signature aux directeurs et sous-directeurs, déménagement dans des locaux qui impliquent de nombreux changements de tâches, introduction de l'informatique.

L'action se déroule en cinq phases :

1ère phase : formulation des problèmes et des thèmes à approfondir ;
2ème phase : étude des problèmes ;
3ème phase : réalisation de 2 premiers projets pilotes ;
4ème phase : lancement de "tous les projets" ;
5ème phase : (en cours) appropriation, par la Préfecture, de l'ensemble de l'opération.

Phase 1 - Formulation des objectifs - Un comité est mis en place, constitué de 30 personnes choisies au sein du personnel, à tous les niveaux, (jusques et y compris les huissiers et les secrétaires). Ce comité comprend, d'une part, les "employeurs" (le Préfet et ses adjoints) et d'autre part des "employés", le plus souvent représentants syndicaux. S'il n'est pas absolument paritaire, ce comité a été accepté à l'unanimité par l'instance paritaire officielle de la Préfecture.

Ce comité a pour première tâche de définir ses propres objectifs et ses propres méthodes. Pour "débloquer la parole", la démarche consiste à faire mener par deux sociologues un interview individuel de chacun des membres du comité et à en tirer un rapport exhaustif.

Ce rapport est envoyé aux 30 membres du comité qui se réunissent en séminaire résidentiel de deux journées. Après une discussion du rapport, la décision est prise d'étudier deux problèmes, celui de la communication et celui des "objectifs" individuels et collectifs.

Prase 2 - ETude des problèmes

Il est décidé "d'interroger" 80 personnes appartenant à 8 services. A ce moment-là, il y a déjà 120 personnes impliquées dans l'action, les 80 nouvelles, 10 interviewveurs , et le comité. Les 10 interviewvers sont choisis au sein de la hiérarchie, jusques et y compris, ici encore, une secrétaire et un huissier.

A la suite de ces interviews, un nouveau rapport est établi avec l'appui des deux nouveaux sociologues[5]; et un nouveau séminaire résidentiel réunit le comité qui pose sept problèmes faisant l'objet de projets d'action-formation ; j'en citerai un comme exemple.: celui des relations"épistolaires " avec le public . Le personnel de la Préfecture se plaint de la difficulté à individualiser les réponses. Elle répond aux gens par des circulaires, par des lettres toutes faites, par des documents imprimés. Or, quand on écrit à la Préfecture, c'est qu'on a un problème spécial, particulier, personnel, sinon on n'écrit pas. Et ce problème tout personnel est justement traité de manière dépersonnalisée.

Phases 3 et 4 - Dans tous les projets, ce sont les personnels eux-mêmes qui font l'étude, les enquêtes, les interviews, les rapports. Chaque projet est dirigé par un conseil de projet, constitué à l'image du comité. Les rapports sont remis à tout le personnel impliqué. Chaque rapport comporte une part de réorganisation des tâches, et des actions de formation qui commencent bien entendu dès l'étude des tâches, et comprennent toujours une partie importante "d'expression écrite et orale" puisqu'il faut interviewver et rédiger et/ou discuter et produire des documents.

Dans le cas de l'accueil épistolaire, une étude systématique des circulaires, des réponses aux lettres est faite par le personnel lui-même qui, en groupes, élabore de nouveaux documents et de nouvelles règles de fonctionnement. Mais pour que les agents soient capables de personnaliser, il leur faut souvent apprendre à mieux comprendre les "cas", donc à mieux analyser les problèmes, et enfin à mieux connaître les "réponses possibles".

Phase 5 - Appropriation de l'action par le collectif . Il avait été décidé, dès le début, que les sociologues et moi-même nous retirerions au bout d'un délai de deux ou trois ans pour que la Préfecture prenne son destin en charge ; prendre en charge, implique deux sortes de mesures : créer une structure institutionnelle d'une part, et former des formateurs au sein-même de la Préfecture d'autre part.

C'est dans cette perspective que plus de 30 formateurs sont recrutés au sein de la Préfecture.

Le terme formateur, pose ici question, celle du sens-même de "formation". Ce problème gêne tout le personnel de la Préfecture. Un formateur dans le cas présent ne forme pas au sens traditionnel du terme. Il est à"l'écoute ", il aide les groupes à transformer leurs besoins en programmes. C'est la raison pour laquelle ces formateurs peuvent et doivent être pris dans la Préfecture car ils doivent être "issus du tas".

Tous ces formateurs sont formés à raison de 3 jours par mois pendant 6 mois, non pas en leur faisant des cours, mais en les faisant réfléchir sur leur travail nouveau. Ils sont impliqués dans les projets.

On en est actuellement à la dernière phase... dernière mais qui sera, je l'espère "éternelle". Les groupes de projets et les formateurs sont en place, les sociologues vont encore à la Préfecture environ une fois par mois, moi je n'y vais plus du tout, et c'est la Préfecture qui, maintenant , fait tourner le système.

Retour à quelques réflexions théoriques

Je ne voudrais pas me substituer aux membres de cette collectivité pour faire à leur place l'évaluation. Je me contenterai de dire qu'à part un certain nombre de gens mécontents, essentiellement ceux, peu nombreux, qui n'ont pas été atteints encore par l'action (30 %) et quelques responsables hiérarchiques mal à l'aise (et cela se comprend dans un système où ils sont pris en "sandwich" par une base qui discute de plus en plus, et un "sommet" qui, bien qu'induisant l'action, n'a pas pour autant changé ses comportements) le personnel est "nettement" satisfait. Les organisations syndicales représentatives veulent la poursuite de l'action et s'en portent garantes, et ce fait est la meilleure défense contre l'attaque ici possiblement renouvelée d'intégration. Oui, ici encore, l'action est intégratrice, mais elle est encore éducative. Oui, ici encore, la motivation est, dans l'ensemble , élevée.

Mais je ne cherche pas un satisfecit. J'ai surtout voulu, en décrivant ces expériences, montrer la cohérence entre les principes énoncés et le déroulement des opérations.

L'analyse des besoins ne se fait pas par un questionnaire. Ce n'est pas en allant trouver des gens et en leur demandant "de quoi ils ont besoin" qu'ils répondront et le sauront. Ce n'est pas non plus en leur offrant un catalogue de cours, qui ne répond jamais à leur attente. Il faut remplacer l'analyse des besoins par l'analyse des "situations-problèmes", premier principe pour accroître la motivation des personnes.

L'évaluation ne se fait pas d'une façon externe, c'est-à-dire par des personnes extérieures. Elle se fait par les formés eux-mêmes. L'évaluation est liée à une nouvelle analyse des problèmes. Elle ne s'exprime pas en disant : ce que j'ai appris est mauvais ou bon ; mais elle se fait en termes de : qu'est-ce que j'ai envie, maintenant , d'apprendre ? quel est le nouveau problème qui se pose à moi ? quelle est ma nouvelle attente?

La formation ne consiste pas seulement à "lire des textes" ou à apprendre des mathématiques ou une technique, elle consiste d'abord à analyser son propre travail, sa propre fonction, ses propres comportements, et son propre changement. La formation devient un second moment, celui où l'on explique ce que l'on vit et sent, où l'on transforme son "expérience" en savoirs.

Mais en faisant cette analyse, l'on aperçoit la limite de telles démarches que le rapport[1] du Conseil de l'Europe souligne très clairement :

> "la globalité garde, pour deux raisons, quelque chose d'inachevé ; il y a projet d'action, mais celui-ci n'émane pas totalement de la collectivité. L'offre éducative cherche à recouvrir tous les paramètres de la demande sociale, sans qu'intervienne une discrimination dans la hiérarchie des problèmes ; les personnes continuent de savoir que les moyens de la résolution ne leur appartiennent pas. L'on peut dès lors s'interroger : quelles motivations majeures détermineraient les individus s'ils ne perçoivent pas, dans les propositions qui leur sont faites, les moyens d'une action efficace ? Qu'est-ce qui susciterait le passage de la passivité à la prise de conscience active ? L'incertitude pèse sur les possibles retombées de ce type de développement, sur la globalité inachevée des retours".

Et c'est pourquoi le rapport du Conseil de l'Europe, dépassant très largement cette perspective, propose de nouvelles formes[6] de participation-globalisation au sein d'espaces régionaux, de districts socio-éducatifs et culturels, districts qui rétabliraient les continuités entre toutes les institutions à vocation éducative, sociale et culturelle, entre éducation et environnement, qui rendraient l'environnement éducatif, le tout dans une perspective d'égalisation des chances (en commençant par les zones désavantagées auxquelles on apportera des ressources) et de responsabilisation (en donnant l'initiative à la base).

References

1. EDUCATION PERMANENTE CCE/EP (77) 8 révisé.
2. Association du Centre Universitaire de Coopération Economique et Sociale - Nancy
3. L'expérience a été menée pendant plusieurs années. Commencée il y a 12 ans environs, elle fait l'objet d'une thèse publiée par Pierre CASPAR, aux Editions "Organisation" - 1970 - "Formation des Adultes ou Transformation des Structures dans l'Entreprise".
4. Et l'on notera qu'aucun des 7 n'y était parvenu jusque là, et ce au moins pour deux raisons : il est difficile et de faire le

passage de la théorie à la pratique, et d'être le seul à utiliser des théories surtout lorsque la hiérarchie supérieure ne les connait pas.

5. qui ont depuis cette date mené l'action. Il s'agit de Michèle Piazza et de Patrick Barrault.

6. Deux expériences déjà existent en Europe, l'une en Belgique, l'autre en Italie, avec l'appui financier de la C.E.E.

7. S'ils ne se formaient pas, ils se sentaient peut-être dépassés.

Résumé

Au cours de cet article on exposera tout d'abord quelques réflexions théoriques sur la responsabilisation du formé (en donnant une description de l'action collective) puis sur la globalisation de la formation.

On décrira ensuite deux applications pratiques en prenant comme illustration deux actions collectives, la première dans une entreprise privée, et la seconde dans une administration française. On concluera par quelques réflexions théoriques sur l'évaluation, et par l'introduction d'une nouvelle forme de participation-globalisation : le district.

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PERSPECTIVE FOR THE MOTIVATION AND INSTITUTIONALIZATION OF CONTINUING EDUCATION IN MEXICO

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1. SENTIDO DEL TERMINO EDUCACION CONTINUA

1.1. Introducción

El hallazgo del alfabeto escrito separó la civilización en dos ámbitos: la historia y la prehistoria. El descubrimiento de la imprenta permitió una subdivisión de nuestra época: antes y después de la letra impresa, recurso repetidor. La intensificación en el uso de los medios electrónicos de comunicación social y el simultáneo desarrollo de la cibernética, dan a la formación moderna una fisonomía de constante cambio y de permanente e intensiva transformación. La información actualizada desempeña un papel de singular importancia ya que la sistematización de datos y la comunicación sustentan el poder y fundamentan el desarrollo eficiente de las organizaciones sociales y, por qué no expresarlo, son la base de la civilización y de la cultura.

Todo esto ha traído consigo la explosión de las comunicaciones, originando un fenómeno de influencia múltiple del que los hombres de todo el mundo no podemos escapar. Hoy el ser humano ha cambiado sus patrones de conducta como ente bio-psico-social y por eso la educación tradicional ha transformado su rostro e incluso su esencia misma.

Casi todos los países en vías de desarrollo fueron, hasta hace un poco más de 40 años, naciones primordialmente rurales y agrarias. Gran parte de sus habitantes vivía del cultivo de la tierra para ganarse el sustento, y las actividades agrícolas absorbían los mayores recursos económicos de las naciones. La motivación de la conducta humana tenía su tiempo y espacio en función de dos polos: el rural y el urbano. La mayor parte de sus habitantes, en las aldeas de provincia, se encontraba diseminada a lo largo de todo el territorio, con escasas y difíciles comunicaciones físicas e intelectuales. Hoy, la modernidad contempla lo que se ha llamado la explosión urbana, o sea el crecimiento anormal de las ciudades. La motivación ha cambiado. La aplicación de reglas y de principios se ha transformado. El hombre es el mismo, pero su conducta responde a más complejos y variados estímulos.

Los países comenzaron a crecer a un ritmo extraordinario. Pero junto al incremento cuantitativo se vive una intensa transformación cualitativa, pues la característica rural de los países se modifica aceleradamente. Las ciudades se han congestionado y las congestiones derivan problemas de empleo, de servicios y de convivencia. Aquí, la educación juega un papel fundamental y la información abarca la casi totalidad de los actos de la vida humana. Han cambiado también, con las transformaciones citadas las respuestas a los estímulos para asegurar que el individuo continúe el proceso de enseñanza-aprendizaje.

1. The meaning of the term continuing education

1.1 Introduction

The discovery of the alphabet divided civilization into two fields: history and prehistory. The discovery of printing made possible a subdivision of our age: before and after the printed word – a repeating resource. The amassing of electronic social comunication media with the simultaneous development of cybernetics gives to the modern information world an aspect of constant change and of permanent and intensive transformation. Updated information plays a singularly important role as systematization of data and communications nourish the power and provide a basis for the efficient development of social organizations which, why not say it? are the basis of civilization and culture.

All of this has brought with it an explosion in communications, the origin of a many–sided influence from which we, the people of the world, can not escape. Today human beings have changed their behaviour patterns as bio–psycho–social beings and have changed the face and even the very essence of traditional education.

Up to a little more than 40 years ago almost all of the developing countries were primarily rural and agrarian. A large part of their inhabitants made their living by tilling the soil, and agricultural activities absorbed the greatest part of the economic resources of a nation. The motivation of human behaviour found its time and space in the terms of two poles: rural and urban. The greater part of their inhabitants were spread throughout all of the territory in provincial villages, and physical and intellectual communication was difficult and scarce. Now, modernity faces what has been called the urban explosion, that is abnormal city growth. Motivation has changed. The application of rules and principles has been transformed. Man has not changed but his conduct responds to more complex and varied stimuli.

Countries began to growat an extraordinary rhythm. However, together with the quantitative growth an intense qualitative transformation is being lived through, the rural characteristics of the countries are undergoing accelerated change. Cities have become congested and problems of employment, services, and living together arise out of the congestion. Here education plays a vital role and information embraces almost all of the acts of human life. Along with the transformations referred to the responses to stimuli have changed as well, to make certain the individual continues the teaching-learning process.

En el otro extremo dramático, se coloca la dispersión de las pequeñas comunidades rurales. Las soluciones son no sólo onerosas sino que, en ocasiones, son imposibles. Esta situación hace difícil el acceso a la educación continua como una opción de desarrollo integral. La educación continua puede consumarse sólo generando mecanismos que aseguren una motivación idónea hacia los sistemas de actualización educativa, y realizarse en tanto que se aseguren procedimientos para captar usuarios para dicha educación. Además, será eficaz sólo cuando logre que dichos usuarios sean capaces de transformar su conducta y asegurar la intensidad del cambio en el quehacer de actualización para beneficio de su progreso profesional y apoyo de las organizaciones a que pertenecen.

1.2. Educación Continua: opción de la modernidad

¿Cómo se debe motivar al adulto para que recorra el siempre apasionante sendero del progreso intelectual? ¿Cómo se puede garantizar que los usuarios del sistema de educación permanente sean suficientemente "adultos" como para cambiar su conocimiento obsoleto y transfomar su conducta mediante información actualizada? ¿Qué elementos se consideran necesarios para que los profesionales se den cuenta de la obsolescencia de sus conocimientos, independientemente de su posición? ¿Cómo podemos vencer la resistencia al cambio, para que empresas y supervisores acepten con honestidad el sendero de la educación permanente? y, una vez asegurada la persuasión, ¿qué pivotes de la conducta vamos a mover para que quienes estén en el sendero de la educación continua sean capaces de ser agentes de cambio?

La respuesta a estas preguntas no admite soluciones empíricas pues en nuestra época conviene no sólo enunciar los objetivos, sino realizar eficazmente las acciones correspondientes. Es urgente responder con rigor científico a estas apremiantes necesidades e impulsar el uso de la educación permanente como filosofía, como propósito, como objetivo y como sistema de actualización, de formación, capacitación y desarrollo.

Se ha insistido cómo, de manera evidente, la educación continua se frena por diversas circunstancias. Analicemos ahora dos aspectos de suma importancia: la motivación de los adultos para que se incorporen al quehacer de educación permanente y el aliento a las organizaciones y empresas para que propicien métodos, sistemas y procedimientos que faciliten dicha incorporación en beneficio tanto de las organizaciones, como de las personas que en ellas se alojan.

1.3. Apoyo para la difusión de la Educación Continua

Se realizó un sondeo preliminar de imagen para conocer el grado de aceptación y/o rechazo a la educación continua entre profesionales de distintas disciplinas, egresados de centros de educación superior tanto privados como oficiales y autónomos. La investigación estuvo a cargo de Asesoría en Desarrollo Empresarial y de Programática, ambas denominaciones sociales.

A continuación se presentan los resultados globales a que nos fue dado llegar. En la primera etapa se indagó sobre el conocimiento del término e implicaciones de "eduación continua o permanente"; de los entrevistados, el 9% afirmó que lo entiende como una filosofía; el 16% se inclinó hacia el término como un mecanismo de actualización; el 40% lo asoció con obsolescencia del conocimiento y superación respectiva; el 35% señaló su ignorancia en relación con el significado. Del 65% de respuestas que se aproximaron al término, cabe destacar que el 80% correspondió a profesionales egresados de diversas disciplinas de la ingeniería. De

The dispersion of small rural communities is located at the other dramatic extreme. Solutions are not only onerous but on occasions impossible. This situation makes access to continuous education as an option for total development difficult. Continuous education can be consummated only through generation of mechanisms assuring suitable motivation towards systems for updating education, and can realize itself when assured of procedures for securing users of said education. In addition, it will only prove effective by achieving that said users are able to change their ways and assure the intensity of the change in the task of updating in benefit of their professional progress and in support of the organizations to which they belong.

1.2 Continuing Education: an option of modern times

How should an adult be motivated to cause him to take the ever exciting road to intellectual progress? How can it be assured that the users of the permanent education system are sufficiently "adult" to exchange their obsolete learning and transform their behaviour through up–to–date information? What elements, other than their awareness, are believed necessary so that professional men will realize the obsolescence of their knowledge? How can we overcome resistance to change so that firms and supervisors honestly accept the path of permanent education? And, once persuasion has been assured, what behaviour pivots are we going to move so that those who are on the road to continuing education are capable of being agents for change?

Answers to these questions do not admit of empirical solutions, since it is advisable in our times not only to point out the objectives but to realize the truth of corresponding actions. It is necessary to respond to these pressing needs with scientific strictness and give impetus to the use of permanent education as a philosophy, as a purpose, as an objective, and as a system for updating, formation, training, and development.

It has been insisted that it is evident that continuing education is being held back by various circumstances. We now analyze two aspects of great importance: adult motivation towards incorporation into the task of permanent education and the encouragement of organizations and firms to support methods, systems, and procedures facilitating said incorporation not only to the organizations' benefit but also of the persons who are lodged in them.

1.3 First obstructor: ignorance of continuing education

A preliminary investigation of image to learn the degree of acceptance and/or rejection of continuing education among professionals graduated from different centers of higher education centers, of several Universities and Institutes supported by the Goverment or by private organizations were done by two different companies: "Asesoría en Desarrollo Empresarial" and "Asesoría en Programática".

The Summary of the Report in the first stage is shown in the next lines. In relation to knowledge of the term "continuing or permanent education", 9% understoodit as a philosophy; 16% were inclined to wards the term as a mechanism for updating; 40% connect obsolescence with personal overcome; 35% ignor the term; 65% has a good aknowledgment of it; 80% of the previous group were engineers. The answers shown that 55% had a good idea of the term.

Investigation into the existence and implications of the obsolescence of knowledge and mechanisms for overcoming it showed the esas respuestas, 55% conocían el término o se aproximaron a él, por los programas intensivos. Del 40%, que señaló su conciencia sobre la obsolescencia del conocimiento, 75% son profesionales relacionados con la ingeniería.

En la segunda etapa se emplearon encuestas con ejecutivos localizados entre mandos intermedios y funcionarios superiores. Sólo el 15% de las organizaciones representadas por dichas personas lleva a cabo programas de capacitación y desarrollo con el enfoque de educación continua; 20% de esas organizaciones se limita a dar a la capacitación la proyección correspondiente a una prestación obligatoria por parte de la empresa, a efecto de cumplir el mandato que constitucionalmente corresponde; 23% de las empresas encuestadas postularon como tesis que la capacitación es sólo una obligación y que, en principio, poco aporta a la productividad y a la eficacia empresarial; el resto, o sea el 42% consignaron que la capacitación se limita a acciones de entrenamiento y que la actualización se suple con otros mecanismos de desarrollo organizacional.

Cabe destacar que los giros de las empresas en donde se practicó la investigación, se advierte que en donde hay vínculos con la ingeniería, es donde se llevan con mayor intensidad programas de capacitación en áreas de educación continua o permanente.

La gravedad de los datos consignados no está en los resultados, sino en las actitudes que de dichos resultados se desprenden. Sobre el particular, en diversos seminarios de investigación se ha explorado el problema, y las tendencias, aunque con variaciones en los porcentajes, son prácticamente las mismas:

2. HIPOTESIS PARA ORIENTAR ESTRATEGIAS DE MOTIVACION ENTRE USUARIOS DE LA EDUCACION PERMANENTE

La educación permanente, como propósito y como sistema, puede mejorarse y optimizar resultados si consolida mecanismos que induzcan a los usuarios hacia la formación e información personal, ya que el hombre, independientemente de su edad, debe tener acceso a un conocimiento sistematizado, actualizado y con perspectivas de aplicación. En la orientación de los motivos se deben desarrollar opciones para el progreso individual, profesional, cultural y humanístico, esté o no el usuario en el seno de organizaciones productivas o de servicios.

Platón elevó la sed de saber a categoría filosófica en el campo del intelecto y es imposible satisfacerla actualmente si el conocimiento no se inserta en una corriente tecnológica y cultural de expansión, desarrollo y especialización, dentro del vertiginoso cambio en nuestro siglo.

Satisfacer esta sed requiere de mecanismos persuasivos que impulsen y orienten la conducta tanto hacia la información como hacia el conocimiento.

La obsolescencia del conocimiento del profesional, se origina sobre todo por cinco motivos básicos:

- Ignorancia del adelanto científico.
- Olvido de los conocimientos adquiridos.
- Incapacidad de asimilar cambios tecnológicos y de aplicarlos a su medio ambiente.
- Falta de patrones y reforzadores de conducta para institucionalizar las innovaciones.

same trend. 12% know the phenomenon and are aware of it; 28% were close to stating their belief in its existence on prodding by the researchers; 60% displayed their complete ignorance.

Worried by the results of this research among professional people, resort was had to executives located between intermediate positions and higher officers. Only 15% of the organizations represented by these people carried out training and development programs addressed towards continuing education; 20% of these organizations limited themselves to a projection of the training corresponding to an obligatory contribution of the firm in order to comply with its constitutional obligation; 23% of the firms researched stated as their thesis that training is only a benefit, and that, in principle, it contributed little or nothing to a firm's productivity and efficiency; the remainder, that is, 42% stated that training is limited to training actions and that updating is provided by other mechanisms, that it has little effect as a productivity and efficiency factor on a firm's life, and that an organization obtains results from structures that have already been tested.

The group that connect obsolescence with personal overcome, 75% were professional related with the engineering field.

We must pointed out that the engineering companies or the ones related with it, are the ones that have the major activity on the continuous or permanent educational programs.

The seriousness of such data does not lie in results but in the attitudes revealed by said results. In this regard, the problem has been explored at many research seminars, and the trends, although the percentages vary, are practically the same.

2. A hypothesis for orientation of motivation strategies among permanent education users.

Permanent education as a goal and a system can be improved and optimize results, if it is able to include mechanisms inducing potential and actual users towards personal formation and information, since a man, regardless of his age, should have access to systematized and updated knowledge with prospects for its application. In motive orientation options should be developed for his personal, professional, cultural, and humanistic development whether or not he is in the bosom of a productive or a service organization.

Plato elevated a thirst for knowledge to a philosophic level in the field of the intellect, and it can not be satisfied if knowledge is not inserted into a technological and cultural current of expansion, development, and specialization within present rapid change. Satisfaction of this thirst requires persuasive mechanisms impelling and orienting behaviour not only towards information but also towards knowledge.

Obsolescence of man's knowledge as a profesional man, above all is brought about by these five basic causes:

- Ignorance of scientific advances.
- Forgetting acquired knowledge.
- Inability to assimilate technological change and to apply it to his environment.
- A lack of behaviour patterns and intensifiers for institutionalization of innovations.

- Modificaciones en los patrones de comportamiento de los mercados de bienes de capital.

Se parte del principio de que la educación continua o permanete es, entre los profesionales, uno de los factores principales para superar la obsolescencia del conocimiento, pero requiere del establecimiento y operación de impulsores y reforzadores de conducta entre los integrantes del sistema.

Además, para asegurar su funcionamiento debe ofrecer:

a) Información sistematizada y actualizada;
b) Formación integral de aptitudes;
c) Inducción de actitudes;
d) Sensibilización hacia el cambio;
e) Creación de conciencia para institucionalizar innovaciones.

Este sistema tiene como principal obstáculo entre profesionales ajenos a la ingeniería, la carencia de una estructura que soporte la aplicación de la tecnología de la educación continua. Esto abarca desde la ignorancia del significado del término "educación continua", hasta el escandaloso fracaso de la aplicación de su tecnología.

Entre los ingenieros sólo se requiere robustecer el conocimiento y predicción de la conducta de quienes son potencialmente usuarios de los sistemas de educación continua; es un tópico que nos obliga no sólo a reflexión, sino que además nos compromete a una investigación profunda.

Las tendencias actuales para precisar con rigor científico cuáles son las aportaciones referidas a la motivación, nos llevarían, en primera instancia, a incursionar en el terreno de la psicología educativa. Empero, es objeto de esta ponencia destacar en nuestro medio en términos generales y a nivel de hipótesis, cuáles son los motivos globales que orientan la conducta del hombre, en concreto del profesional, para sujetarse a las reglas de la actualización y para incursionar en el campo de la educación permanente, institucionalizada como factor de desarrollo.

Se pretende resaltar algunas estrategias para inducir al profesional a luchar contra la obsolescencia del conocimiento y para que conozca algunos de los medios para superarla. Estas estrategias se relacionan de manera directa con la filosofía misma de la educación permanente, la que abordaremos desde el ángulo de enfoque que la vincula con el ingeniero mexicano, como sujeto de la misma.

Se propone la educación continua como estrategia de institucionalización, esto es, como elemento de soporte en la planeación, operación y control de mecanismos de innovación y desarrollo técnico y administrativo en el seno de empresas y organizaciones usuarias del sistema, para crear nuevos patrones normativos y de acción y así elevar la eficiencia y la eficacia, tanto de los individuos en lo particular como de las instituciones en general.

Por último, se plantean mecanismos específicos, destinados al logro de los propósitos enunciados, a través de técnicas de movilización social, para alentar la institucionalización de la educación continua como agente de cambio y complementación de los sistemas de educación formal y escolarizada.

3. IMPACTO DE LA MOTIVACION EN EL PROCESO DE LA EDUCACION CONTINUA

3.1. Los problemas

El sistema de Educación Continua consta de tres subsistemas principales: recepción usuarios-beneficiarios; emisión-docencia-in-

- Changes in the behaviour patterns of capital goods markets.

The basis is the principle that continuous or permanent education is, among professional men, one of the main factors in overcoming obsolescence of knowledge, but he establishment of the operation of behaviour instigator and intensifiers in the system's makeup ir required for it to operate. Further, in order to make certain of its operations it should offer:

a) Systematized and updated information;

b) Complete formation of aptitudes;

c) the induction of attitudes;

d) sensitizing towards change;

e) creation of awareness for institutionalization of innovations.

The principal obstacle to this system is the lack of a structure to support the application of continuing education technology. This encompasses from ignorance of the meaning of the term "continuing education" to a disgraceful failure in application of its technology.

The knowledge and prediction of conduct by thos who are the potential users of continuing education systems is a topic that not only causes thought but also makes extensive research obligatory.

Present trends for stating with scientific certainty precisely what said contributions to motivation are, would lead us, in the first place, into an invasion of the field of educational psychology.

However, it is the object of this paper to underline at a hypothetical level what are the overall motives underlying man's behavior —precisely the professional man— in our medium in general terms, and to subject it to updating rules and to make an incursion into the permanent education field.

It is sought to cause some strategies for inducing the professional man to struggle against obsolescence of knowledge to stand out and to learn some of the measures for overcoming it. Such strategies are directly related to the very philosophy of permanent education, which we shall approach from the angle joining it to the Mexican professional man as its subject.

In addition continuing education is proposed as an institutionalization strategy, that is, as an element of support in the planning, operation, and control of innovation and technical and administrative development mechanisms, in the bosom of the firms and organizations using the system, to create new normative and action patterns, and, thus, to elevate the efficiency and the efficacy not only of individuals in particular but of the instituions in general.

Finally, specific mechanisms destined for achievement of these proposals through social mobilization techniques are proposed, to encourage institutionalization of continuing education as an instrument for change supplementary to formal and academic education.

3. Impact of motivation in the continuing process

3.1 The Problems

The Continuing Education System comprises three main subsystems: user—beneficiary—reception; emission—teaching—research;

vestigación; administración-apoyo logístico-servicios; y de otros subsistemas secundarios que caracterizan a los centros de educación superior en el enfoque tradicional. El subsistema de recepción usuarios-beneficiarios se desarrolla en dos niveles de operación: el de las empresas, organismos e instituciones que apoyan el desarrollo de sus recursos humanos —nivel institucional—, y el de los individuos que de manera particular requieren y aceptan servicios del Sistema de Educación Continua —nivel individual-.

Uno de los aspectos más importantes para consumar a plenitud los objetivos de la educación continua consiste en establecer mecanismos eficientes y eficaces de motivación, entendida ésta, con Friedrich Dorsch, como el trasfondo psíquico, impulsor, que sostiene la fuerza de la acción y señala su dirección.

El curso del acontecer humano depende de la orientación que se da a la conducta para asegurar acciones u omisiones. De ahí se derivan las perspectivas y probabilidades para aceptar o rechazar un fenómeno o un problema, o para permanecer indiferentes o comprometidos hacia una situación o un hecho.

En la tercera etapa de esta investigación se indagó, entre personas que han sido usuarias del sistema de educación continua, el grado de aceptación o rechazo de este sistema.

Sólo el 7% manifestó estar plenamente satisfecho; el 25% consignó como deficientes los servicios administrativos, como superficial y de poco rigor científico la información proporcionada, y con escasa aplicabilidad al contexto laboral. El 30% señaló problemas serios por no haberse cubierto las expectativas con que su grupo incursionó en el sistema de educación continua. El restante 25% afloró una profunda insatisfacción y esbozó una actitud de total desencanto.

Con las limitaciones del caso, se exploró entre diversos centros, institutos, escuelas y facultades que ofrecen el servicio de educación permanente. Se hicieron diversos hallazgos:

a). Existen limitaciones de carácter presupuestal para proporcionar docentes de calidad, conferenciantes de nivel relevante o expositores con experiencia.

b). Se tuvieron además dificultades para desarrollar trabajos serios de investigación, para detectar, en su justa dimensión, las necesidades de empleadores, la relación oferta-demanda de especialistas, las tendencias de demanda de información especializada sobre tópicos concretos y la dispersión de repositorios con datos para integrar un ordenamiento tendiente a una programación metódica, congruente y racional.

c). Se evidenciaron carencias de material didáctico preparado expresamente para eventos de este tipo de educación.

d). Se puso de relieve finalmente, que hubo premura y tensión inusitada para planear, organizar, impartir y evaluar cursos.

e). La obsolescencia del conocimiento sobre la tecnología de educación continua, también ha llegado, paradójicamente, a quienes tienen a su cargo el quehacer de educación continua.

En la misma exploración y en contraste con las deficiencias halladas en otras organizaciones que ofrecen servicios de educación continua, para fortuna de la educación permanente en México, también se detectaron centros en los cuales los problemas citados se han superado en buena medida, gracias al empleo de mecanis-

administration—logistic support—services; and other secondary subsystems traditionally characteristics of higher education centers. The reception—user—beneficiary subsystem develops on two operational levels: that of the firms, agencies, and institutions supporting the development of their human resources —the institutional level— and that of the individuals who particularly need and accept services from the Continuing Education System —the individual level.

One of the most important aspects for the full consummation of the objectives of continuing education consists in the establishment of efficient and efficacious motivation mechanisms, this being understood, with Friedrich Drosch, as the impelling, psychic background supporting the force and indicating the direction of the action. The course of human conduct dependes on the orientation given to behavior to make certain of acts and omissions. Thence are derived prospects and probabilities for the acceptance or rejection of a phenomenon or a problem, or to remain indifferent to or involved in a situation or a fact.

During the third stage of this research, inquiry was made of the degree of acceptance or rejection of the system of continuing education among persons who have been users of this systems.

Only 7% indicated their complete satisfaction; 25% stated that administrative services were deficient, that the information furnished was superficial and of small scientific precision and small application in the labor context. 30% referred to serious problems because the expectations with which their group had entered into the continuing education system had not been met. The remaining 25% came out with a partial dissatisfaction and outlined an attitude of disenchantment. Several centers, institutes, schools, and faculties offering permanent education service were investigated. Various findings were made:

a) There are budgetary limitations against furnishing qualified teachers, relevant level lecturers, or experienced exponents.

b) Difficulties were also encountered in the development of serious research work, for detection of the proper dimension of employers' needs, the supply and demand relations of specialists, trends in the demand for specialized information on concrete topics, and the dispersion of data repositories to establish an order tending towards methodical, congruent, and rational programming.

c) There was evidence of a lack of didactic material expressly prepared for the contingencies of this type of education.

d) Urgency, unusual tension in the planning, organization, impartment, and evaluation of courses finally stood out.

e) Paradoxically, obsolescence in the technology of continuing education has finally reached those in charge of the task of continuing education.

During the same research, and in contrast to deficiencies encountered in other organizations offering continuing education services (luckily for permanent education in Mexico) centers were also found in which the problems referred to have in good measure been overcome, thanks to the employment to updated permanent education

mos actualizados de institucionalización de educación permanente, sobre los que después abundaremos. Su estrategia principal ha sido el desarrollo de mecanismos de reforzamiento conductual y de aplicación de métodos innovados para educar, formar, informar y sensibilizar adultos, que con una automotivación, por necesidades de movilidad en las posiciones jerárquicas que desempeñan o por mera gratificación personal vinculada al conocimiento, o por motivos de cambio de empleo, han acudido con toda madurez, empeño y conciencia a dichas instituciones. El éxito se debe, a juicio de los patrocinadores, organizadores y usuarios, a la promoción motivacional, que genera, en primer lugar, conciencia sobre la filosofía de la educación continua, y después a la cuidadosa programación de eventos, a la velocidad de respuesta para preparar material didáctico y de desarrollo de diversa índole. Pero sobre todo se debe a un fácil acceso a la información preliminar sobre las expectativas de cada evento particular y a las posibilidades de configurar sistemas de programación educativa integral.

Por lo anterior sabemos que resulta recomendable y aun indispensable, remarcar la necesidad de asegurar la orientación de los motivos que inducen a la programación de sistemas de educación continua. Dicha orientación se debe referir, en primer término, al individuo sujeto a una serie de mecanismos que dan pauta a su comportamiento. En segundo lugar, a las empresas, organismos e instituciones que alientan el sistema como estrategia de modernización organizacional y de desarrollo institucional. En tercer lugar, a los centros que de manera directa o indirecta utilizan el sistema de educación continua.

3.2. Proximidad a la motivación del usuario potencial del Sistema de Educación Continua

Para superar los problemas detectados, los mecanismos de motivación probados han de inducir al usuario potencial a la satisfacción de sus necesidades básicas.

Las principales necesidades básicas del ser humano son: seguridad en su modo y estilo de vida; afán de progreso y reconocimiento en sus aspectos profesional, laboral e intelectual; sed de estructuración de tiempo, orientada a la distribución de los lapsos que conforman el devenir de acciones de cada día; correspondencia entre esfuerzo de perfeccionamiento y remuneración respectiva; intencionalidad para ascender a mejores oportunidades de progreso en la pirámide jerárquica; oportunidad para desarrollar nuevas experiencias y superar las crisis que se derivan con el vértigo del cambio.

Por otra parte, como salidas laterales de los mecanismos de motivación, los eventos de educación continua deben incluir facilidades para obtener nuevas relaciones profesionales, tanto interdisciplinarias como multidisciplinarias; opciones para permanencia y acceso a grupos formales e informales; y perspectivas para transformar las rutinas en función de los adelantos tecnológicos de eficiencia probada.

Todos estos pivotes de inducción personal para los usuarios potenciales, deben cubrirse no sólo en los medios de publicitación y propaganda de los eventos de educación continua, sino además, han de incorporarse a los métodos, sistemas y procedimientos de enseñanza-aprendizaje que se utilicen en el proceso de educación permanente.

La relación entre la motivación y la voluntad, como señalan Dorsch, Morgan, Berlo y Aranguren, entre otros, lleva a señalar con precisión opciones para desviar, inhibir y aun invertir impulsos y tendencias instintivas. Las perspectivas de su aplicación llevan, como señala Hellpach, al descubrimiento e inducción de constan-

institutionalization mechanisms, wich we shall deal with more fully later. Their main strategy has been development of behavior reinforcing mechanisms and the application of innovative methods for the education, formation, information, and sensitization of adults, who, by selfmotivation, through mobility needs in the hierarchic positions they fill or for mere personal satisfaction joined to knowledge, or because of changes in employment, have attended said institutions with complete màturity, committment, and reliability. In the judgment of its sponsors, organizers, and users, its success is due to its motivational promotion, which, in the first place, gives rise to an awareness of the philosophy of continuing education, and, then, to the careful programming of events, to the speedy response in the preparation of didactic, and a different kind, of development material. But, above all, it is due to easy access to preliminary information on the expectations of each particular event and the possibilities for configuration of integral education programming systems.

Therefore, we know it is advisable, and even indispensable, to refer again to the need for making certain of the motivational orientation influencing the programming of continuing education systems. In the first place, this orientation should refer to the individual subject to a series of mechanisms serving as guidelines for his behavior; and, in the second place, to the firms, agencies, or institutions encouraging the system as a strategy of organizational modernization and institutional development; and, in the third place, to those centers directly or indirectly making use of the continuing education system.

3.2 Proximity to the motivation of the potential user of the potential of the Continuing Education System

In order to overcome the problems that have been detected, proved motivation mechanisms must persuade the potential user towards satisfaction of this basic needs.

A human being's principal, basic needs are: security in his manner and style of life; an eagerness for professional, working, and intellectual progress and recognition, a thirst for organization of his time, oriented to distribution of the periods causing development of the actions of each day; a correspondence between the effort for improvement and its respective remuneration; intentionality to rise to greater opportunities for progress in the hierarchy pyramid; an opportunity to develop new experiences and to overcome the crisis due to the accelerated rhythm of change. On the other hand, as lateral outlets of motivation mechanisms, continuing education events should include facilities for obtaining new interdisciplinary and multidisciplinary professional relations; options for remaining in and acces to formal and informal groups; and prospects for the transformation of routine in relation to technological advances of proved efficiency.

All of these pivots of personal influence of potential users should be covered not only in the publicity and advertising media for the events of continuing education, but also have to be incorporated in the teaching-learning systems and procedures and methods utilized in the permanent education process.

The relation between motivation and will, according to Dorsch, Morgan, Berlo, and Aranguren, among others, lead to a precise indication of the options for diverting, inhibiting, and even inverting instinctive impulses and tendencies. Prospects for its application, tes motivos, equivalentes a la posesión de un modo de ser que asegura la aparición de motivaciones y refuerza las tendencias del cambio.

Se trata también de evitar petrificaciones o estereotipos que, disfrazados o disimulados, son importantes en las relaciones humanas de los usuarios del sistema de educación permanente, pues la sociedad humana no permite a la larga mantener sin variación las motivaciones que se propone. Las motivaciones van perdiendo fuerza del mismo modo que se debilitan en el recuerdo y son reemplazadas continuamente por nuevas motivaciones, en cuyo planteamiento coincidimos plenamente con Krueger.

Durante el desarrollo de los eventos de educación continua los mecanismos de motivación de sus usuarios, además de incorporar la satisfacción de las necesidades básicas enunciadas, deben facilitar la operación de procesos para que, durante el ciclo de enseñanza-aprendizaje, se asimilen, adopten y operen reforzadores de conducta que aseguren modificaciones en el comportamiento profesional, y para que los nuevos conocimientos y experiencias adquiridas no caigan rápidamente, a su vez, en obsolescencia.

Resulta importante además, que la educación continua prevenga la modificación de las *mesetas* tradicionales en el curso del aprendizaje, esto es, que las líneas horizontales que indican una detención transitoria o permanente del curso ascendente de una curva de aprendizaje, sean seguidas de los reforzadores necesarios para alentar constancia en la asimilación y disciplina –tan desacostumbrada en el medio–. Sólo así, a la adquisición de aptitudes, capacidades y habilidades, se seguirá necesariamente un esfuerzo intensivo para la solución de problemas vinculados con el medio ambiente laboral del usuario.

Otro mecanismo de motivación, aconsejable para despertar interés durante el proceso de enseñanza-aprendizaje en el sistema de educación continua, es facilitar en los subsistemas de emisión-recepción, el empleo de métodos incorporados a objetivos educacionales y a conductas terminales. Todo esto para que los usuarios conozcan con profundidad lo que deben aprender, para qué aprender, dónde aplicar lo aprendido y cómo desarrollar estrategias que comuniquen las innovaciones, de manera que les reporten beneficios y sean fuente de gratificaciones, que no existirían sin la operación de los sistemas de educación continua.

3.3. Apoyo de las organizaciones para motivar el uso del sistema

En el ámbito de las organizaciones, empresas e instituciones usuarias del sistema de educación continua, los mecanismos de motivación adoptan otras modalidades pues nos movemos en el terreno de la venta de servicios. El empresario, el ejecutivo, el funcionario, según se trate del sector público o privado, aducen diversas razones para desconfiar de los sistemas de educación permanente, como por ejemplo, falta de tiempo, en supervisores y trabajadores, para actividades de información y formación, o limitaciones de carácter presupuestal y financiero. Como argumento aducen la carencia de resultados visibles, objetivos y concretos derivados de la acción de los sistemas de educación continua. Conforman pautas de conducta, resistentes a la facilitación del proceso, bien por desconocimiento de la filosofía de este sistema educativo o por experiencias personales que fueron muy desafortunadas. Advierten, además, serios riesgos en la organización, pues carece de un procedimiento que vincule escalafón-ascenso-capacitación-remuneración.

Si las razones anteriores no fueran suficientes para generar situaciones de reticencia hacia la educación permanente, hay otra de

Hellpach says, lead to the discovery and influence of constant motives, equivalent to a possession of a way of life assuring the appearance of motivations and the reinforcement of tendencies towards change. An effort is also being made to avoid disguised or dissimulated petrification or stereotypes, which are important in the human relations of permanent education system users, because human society does not long permit the proposed motivations to be maintained without change. Motivations lose their force just as they become weakened in the memory and are continually replaced be new motivations, in the introduction of which we are in full agreement with Krueger.

During development of the events of continuing education their users' motivations, in addition to incorporation of satisfaction of the basic need enumerated, should facilitate the operation of processes, that, during the teaching-learning cycle, assimilate, adopt, and operate behavior fortifiers assuring changes in professional behavior, and so the new knowledge and experience do not, in turn, become rapidly obsolete.

It is also important that continuing education foresee changes in the traditional *plateaus* in the course of learning, that is, that the horizontal lines indicating a transitory or permanent interruption in the ascending course of a learning curve, are followed by the reinforcer needed to encourage constancy in assimilation and discipline – so unaccustomed in the medium. Only in this manner, by acquisition of aptitudes, capabilities, and abilities will an intensive effort be fellowed for solution of the problems linked to the user's working environment.

Another motivational mechanism, advisable for awakening interest during the teaching-learning process in the continuing education system, is to facilitate the employment of methods incoporated into educational objectives and terminal conduct in emission-reception subsystems. All this so that the users know what they should learn in depth, why they are learning, where to apply what is learned, and how to develop strategies for communication of innovations, so that they benefit them and are a source of satisfaction which would not exist without the operation of continuing education systems.

3.3 Support of organizations to motivate use of the system

Within the ambit of the organizations, firms, and institutions which are users of the continuing education system, motivation mechanisms take other forms, as we are not in the service sales field. The manager, the executive, and the official, according to whether the public or private sector is involved, give different reasons for a lack of confidence in permanent education systems, as, for example, a lack of supervisors' and workers' time for formation or information activities, or limitations of a budgetary or financial nature. By way of argument they cite the lack of visible, objective, and concrete results derived from the action of continuing education systems. They adopt conduct guidelines, resistant to facilitation of the process, either from ignorance of the phylosophy of this educational system or because of most unfortunate personal experiences. Further, they warn of serious risks in its organization, since it lacks a procedure linking seniority-list-promotion-capacitation-remuneration.

If the foregoing reasons were insufficient to arouse reticence towards permanent education, there is another, or greater, burden:

mayor peso: la duración de los cursos o seminarios alojados en el sistema de educación continua. Se añade, por otra parte, el descrédito de la estrategia capacitación-productividad.

Esos elementos negativos pueden superarse en buena medida, si los centros e instituciones que ofrecen el servicio, son capaces de involucrar nuevas estrategias de venta y, en consecuencia, de persuasión hacia los empresarios y funcionarios, los cuales están acostumbrados al lenguaje de los mensajes que se insertan en lo pragmático, en la obtención de resultados, en argumentaciones de carácter financiero y en la vinculación de los factores costo-beneficio, rentabilidad, obtención de utilidades.

Por estas razones nos vemos obligados a destacar la importancia de que en nuestros centros de educación continua se generen investigaciones destinadas a indagar cuáles son los motivos que orientan la conducta de los patrocinadores en calidad de instituciones; y a generar la operación de estrategias modernas para acompañar la educación continua de beneficios colaterales como el de la institucionalización, al cual nos referiremos más adelante, y además, a involucrar estrategias globales y compartidas como la de movilización social, sobre la que también abundaremos.

El objetivo de esta motivación, dirigida al nivel de las instituciones patrocinadoras, es persuadir a las organizaciones para que ocupen y empleen a plenitud la capacidad instalada de los centros de educación continua, en beneficio de las mismas organizaciones y para el progreso de los individuos que se alojan en ellas.

3.4. Acciones iniciales para inducir programas optimizados de educación continua

Los tres elementos citados del sistema: individuo, organizaciones a las cuales pertenece e instituciones de educación continua, deben interactuar, interrelacionarse e intercomunicarse a efecto de llevar a cabo, hasta sus últimas consecuencias, las etapas lógicas de un proceso, del que dependerá, según la estrategia de la motivación, el éxito del sistema. Dicho proceso involucra en los oferentes de educación permanente:

- Detección de las necesidades de información, formación, capacitación, desarrollo, sensibilización, educación o simplemente de adiestramiento, existentes en las entidades potencialmente usuarias del sistema y que se relacionen con la actualización del conocimiento, especialmente con la instrumentación de planes y programas de educación continua en función de las necesidades detectadas.

- Investigación de los impulsores y frenadores que orientan al individuo hacia los sistemas escolarizados o desescolarizados, formales o informales de educación permanente, para satisfacer expectativas y orientar los motivos que inducen su conducta.

- Conocimiento de la relación oferta-demanda de trabajo en función de empleadores y de las necesidades previsibles a corto, mediano y largo plazo, para alimentar el sistema de planeación y programación de eventos de educación continua, y no frustrar las salidas y resultados concretos en beneficio de los usuarios.

- Sondeo de la imagen de aceptación o rechazo que se genera al ofrecer planes y programas de actualización y de educación permanente, en base a las tendencias detectadas en los sistemas de educación y de su vinculación auténtica y real con la realidad económica y social del país.

the length of the courses or seminars lodged in the continuing education system. On the other hand can be added the disrepute of the capacitation productivity strategy.

Such negative elements can be overcome to a great extent, if the centers or institutions offering the service have the ability to make use of new sales strategies, and, consequently, of persuasion of managers and officials, who are accustomed to the language of pragmatic messages, to obtaining results, to financial-type arguments, and to linking cost-benefit factors, probitability, and securing profits.

We are obliged for these reason to underline the importance originating research in our centers of continuing education intended to inquire into the motives orienting sponsors' behavior as institutions; and originate the operation of modern strategies to accompany continuing education with collateral benefits, like institutionalization, to which we will refer below, and further, to involve global and divided strategies, such as social mobilization, upon which we will also speak more fully.

This motivation's objective, addressed at the level of sponsoring institutions, is to persuade organizations to occupy and employ the plentiful installed capacity of continuing education centers to the benefit of the organizations themselves and towards the progress of individuals located in them.

3.4 Initial actions to influence optimized programs of continuing education

The three elements of the system referred to – individual, organizations to which he belongs, and institutions of continuing education – should interect, interrelate, and intercommunicate in order to carry out, to its final consequences, the logical stages of a process, upon which, in accordance with the strategy of the motivation, the success of the system will depend. Said procedure involves the offerers of permanent education in:

- Detection of the need for information, formation, capacitation, development, sensitizing, education or simply training, of the entities that are potential users of the system, which is related to updating knowledge, particularly in the implementation of continuing education plans and programs in accordance with discovered needs.

- Research into the drives and curbs orienting an individual towards scholasticized or descholasticized formal or informal systems of permanent education, to satisfy expectations and orient the motives influencing his behavior.

- Knowledge of the labor supply and demand relationship in function of employers and short, medium, and long-term foreseeable needs to feed events into the system for planning and programming continuing education without frustrating the output and concrete results benefitting user

- A probe of the image of acceptance or rejection originated by the offer of updating and permanent education plans and programs, based on tendencies detected in educational systems and their authentic and real bond with the country's economic and social reality.

- Creación de mecanismos de persuasión para incitar al uso de la educación permanente como medio de desarrollo individual, de progreso profesional y de extensión humanista y cultural de quienes potencialmente son candidatos al uso de los sistemas de educación continua.
- Detección de los elementos necesarios para asegurar el reforzamiento de la conducta, tanto en términos de aprendizaje como en función de las conductas terminales que se esperan del sistema integrado de educación permanente.
- Investigación sobre la relación costo-usuario del sistema, para asegurar el adecuado apoyo logístico de la operación del proceso de enseñanza-aprendizaje.
- Ofrecimiento de mecanismos que faciliten la acreditación de materias insertas en los currícula de estudios a nivel de postgrado.
- Persuasión a empresarios y funcionarios sobre la conveniencia de vincular los escalafones, el sistema de remuneración, el sistema de ascensos y reconocimientos con los procesos de educación continua.
- Establecimiento de procesos facilitadores que consideren las variables: tiempo, espacio y acceso al sistema, en función de los modos y estilos de vida de los usuarios potenciales.
- Impulsar a los sistemas de educación personalizada a distancia, relacionados con mecanismos de acreditación.
- Preparación de paquetes y material didáctico que ayude al autoaprendizaje. Los usuarios disfrutarán de la misma calidad, profundidad y orientación de los sistemas tradicionales de enseñanza-aprendizaje.
- Compatibilización de bancos de datos para intercambio de información con centros de propósitos afines.
- Elaboración de indicadores de calidad de los resultados que se deriven del sistema de enseñanza-aprendizaje.
- Creación de métodos y procedimientos que sigan el desarrollo de los usuarios del sistema de educación después de terminado el ciclo de enseñanza-aprendizaje.

4. RESISTENCIA A LA EDUCACION CONTINUA O PERMANENTE

Durante la cuarta etapa de la investigación, se seleccionaron de entre los encuestados, usuarios potenciales y reales de la educación continua, ya sea en función de individuos para que manifestaran su criterio independiente, ya sea como ejecutivos y funcionarios, para que representaran el criterio de sus organizaciones e instituciones. El objetivo de esta parte de la exploración, fue conocer los principales factores que generan resistencia al uso de sistemas de educación permanente.

A fin de superar el problema de la exposición de los resultados cuantitativos, y a efecto de precisar su interpretación cualitativa, por razones de espacio se omite la presentación de porcentajes.

Los sistemas de motivación pueden ser obstruidos, entre otros, por los siguientes hechos, situaciones o circunstancias.

- Creation of persuasion mechanisms to induce the user of permanent education as a means for individual development, or professional progress, and the humanistic and cultural extension of whomever is a potential candidate for the use of continuing education systems.
- Detection of the elements required to assure reinforcement of behavior in terms of learning and in fuction of the terminal behavior expected from an integrated system of permanent education.
- Research into the system's cost-user relationship, tu assure suitable logistic support of the operation of the teaching-learning process.
- Offer of mechanisms facilitating the giving of credit for subjects inserted into study curricula at the postgraduate level.
- Persuasion of management and officials of the advisability of linking seniority lists, the remuneration system, and the promotion and recognition system with continuing education processes.
- The establishment of processes facilitating consideration of the variables, of time, space, and access to the system, in function of the manner and life style of potential users.
- Provide impetus from a distance to personalized education systems related to mechanisms for giving credit.
- Preparation of packages and didactic material to assist self-education. Users enjoy the same quality, depth, and orientation as the traditional teaching-learning systems.
- Compatibilization of data banks for the interchange of information with centers of kindred purposes.
- Preparation of indicators of the quality of the results of teaching-learning systems.
- Creation of methods and procedures to follow the development of users of the educational system after termination of the teaching-learning cycle.

4. RESISTANCE TO CONTINUING OR PERMANENT EDUCATION

During the fourth stage of the research, potential and actual users of continuing education were selected from among those surveyed, either as individuals to permit statement of their independent criteria, or as executives and officials to represent the criteria or their organizations and institutions. The objective of this part of the exploration was to learn the main factors originating resistance to the use of permanent education systems.

To overcome the problem of a statement of quantitative results, and for the purpose of precisely stating their qualitative interpretation, the presentation of percentages is omitted for reasons of space.

The following facts, situations, or circumstances, among others, can obstruct motivation systems:

4.1. Falta de conciencia sobre el fenómeno de la obsolescencia del conocimiento

El trabajador, el supervisor, el funcionario o el ejecutivo, tanto del sector público como del privado, tienen la convicción de que su quehacer se lleva a cabo eficiente y eficazmente. Parten del supuesto de que, desde su egreso de los centros educativos superiores, sus conocimientos aunados a la experiencia derivada del ejercicio de sus funciones, bastan para desarrollar a plenitud las tareas encomendadas. El crecimiento de la organización donde prestan sus servicios es su punto de referencia para ubicar la funcionalidad de sus conocimientos. Además, la escasa atención de las instituciones para alentar con intensidad programas de entrenamiento, adiestramiento, capacitación y desarrollo, limitan la visión de su personal hacia los adelantos tecnológicos adoptados, se suponen eficientes y eficaces en esas organizaciones en el sentido de que han asegurado resultados.

4.2. Ignorancia de métodos y sistemas optimizados de enseñanza-aprendizaje

El egresado de los centros de educación superior se vincula a la vida económica del país con un determinado caudal de conocimientos. La información que posee no siempre se halla respaldada por experiencias de campo. La relación egresado-organización productiva o de servicios, existe sólo desde el supuesto de que los planes y programas de estudios satisfacen las necesidades operativas de empresas, organizaciones e instituciones.

Hasta antes de la actual década, el proceso de enseñanza-aprendizaje conservaba fuertes reminiscencias de la educación tradicional. La ausencia de objetivos educacionales y de conductas terminales definidos en un espacio (e) y un tiempo (t) diversos del espacio (e) y el tiempo (t) característicos de la realidad operativa de las organizaciones, cambiaban considerablemente las perspectivas en la comunicación de innovaciones, pues no se aseguraba idóneamente la motivación para el autoaprendizaje, ni se proporcionaban técnicas eficientes para tal propósito.

4.3. Falta de tiempo para emprender y consumar el quehacer de actualización

Uno de los problemas más serios que se afrontan en nuestra época consiste, al parecer, en la falta de tiempo para hacer las cosas. Como no se cuenta con el tiempo suficiente, se generan presiones y se originan dificultades laborales y surgen problemas que van desde la intranquilidad personal hasta la ausencia de resultados óptimos vitales. Desde luego, se aduce falta de tiempo para no actualizar el conocimiento. Tal parece que se ignora cómo el tiempo es independiente de nuestra conciencia. Los principales interesados en actualizar el conocimiento no han podido resolver a plenitud la sed de estructuración del tiempo; dos grilletes les atan de manera constante: la agenda y el reloj. Las jornadas de trabajo y el cúmulo de asuntos encomendados a cada unidad operativa se destinan más a aspectos rutinarios que de planeación y preparación programática. Las labores de supervisión y control consumen otra parte importante del tiempo.

Los lapsos disponibles para colocar al ejecutivo en contacto con los más recientes descubrimientos y con el avance tecnológico, se restringen de manera directamente proporcional al volumen y cargas de trabajo encomendados.

El planteamiento de factores que faciliten la asistencia de recursos humanos a eventos formales de actualización permanente, se ve frecuentemente no sólo con recelo, sino que genera inusitadas reservas.

4.1 A lack of awareness of the phenomenon of the obsolescence of knowledge

The worker, supervisor, official, or executive, whether in the public or private sector is convinced that his task is performed efficiently and efficaciously. They start with the supposition that, since they left higher centers of education, their knowledge plus their experience originating in the performance of their functions is sufficient for the full performance of the tasks entrusted to them. The growth of the organization where they render their services is a point of reference for locating the functionality of their knowledge. In addition, the scant attention of the institutions to serious encouragement of training, instruction, capacitation, and development limit the vision of their personnel towards technological advances which have been adopted and are supposed efficient and efficacious by such organizations in the sense that they have produced results.

4.2 Ignorance of optimized teaching-learning methods and systems

The graduate of centers of higher education joins the country's economic life with a certain abundance of knowledge. His information is not always backed up with experience in the field. The relation of a graduate to a productive or service organization can exist only on the supposition that the study plans and programs satisfy the operational needs of firms, organizations, and institutions. Up to this decade, the teaching-learning process was highly reminiscent of traditional education. A lack of educational objectives and of terminal behavior, defined in a space(s) and a time (t) differing from the scope (s) and the time (t) characteristic of the operational realities of the organizations changed innovation communication prospects considerably, since the motivation for self-education or provision of efficient techniques for such purpose was not assured.

4.3 Lack of time for undertaking and consummation of the task of updating

One of the serious problems facing us in our times apparently consists of a lack of time for doing things. As there is not sufficient time, pressures are generated and originate labor difficulties and problems – from personal uneasiness to the absence of vital optimum results. Of course, the lack of time is adduced as a reason for not updating knowledge. It would appear that there is ignorance that time is independent of our awareness. Those mainly interested in updating knowledge have not been able fully to solve the thirst for structuring of time; they are constantly bound by two shackles: their appointment book and their watch. Working days and the accumulation of matters entrusted to each operative unit are directed more towards routine aspects than to program planning and preparation. Labors of supervision and control consume another important part of time. Periods available for putting an executive in contact with the most recent discoveries and with the advance of tecnology are restricted in a manner directly proportional to the volume and load of work entrusted to him.

The offer of factors facilitating the attendance of human resources at formal permanent updating events is frecuently viewed not only with misgivings but occasions unusual reservations.

4.4. Carencia de recursos para costear el quehacer de educación continua

El impacto de la modernidad sobre los grados de competencia mercantil entre las empresas, la diversificación de productos y el acceso a la sociedad de consumo, en especial a la de consumo ampliado, obligan a la operación de presupuestos en los que pocas veces se contempla un volumen financiero importante destinado a la actualización y desarrollo de trabajadores y supervisores.

Las legislaciones del mundo, en su inmensa mayoría se han preocupado por incorporar mecanismos legales que tutelen la capacitación como una obligación y como un derecho; sin embargo, como no a toda actualización sigue una transformación inmediata en resultados, el aliento a dichos programas alcanza a un porciento mínimo de los recursos humanos alojados en el seno de las organizaciones.

Además, el impacto de los mecanismos inflacionarios y la carrera de sueldos, salarios y prestaciones contra el costo de la vida, obliga a un gran número de personas a remitir sus presupuestos a la satisfacción de necesidades ajenas a la actualización del conocimiento. Las limitaciones presupuestales de los empleadores, aunadas a las carencias de recursos económicos de los trabajadores para sufragar por sí mismos el costo de la actualización, generan un ciclo vicioso, donde: no se actualiza el conocimiento porque no hay recursos financieros, y no se incrementan los recursos financieros porque no hay actualización del conocimiento.

4.5. Imposición del quehacer de actualización mediante la relación laboral

Por lo que hasta el momento puede advertirse, las organizaciones e instituciones optan por alentar entre sus recursos humanos el quehacer de actualización, acudiendo a la estrategia de no sensibilizar previamente a los usuarios potenciales, y se impone al personal la tarea de asistir a eventos de adiestramiento o de desarrollo, mediante mecanismos de coacción amparados en la obligación del quehacer de capacitación. Se ofrece como motivación, el facilitar a los usuarios dichas actividades durante los horarios de trabajo.

El empleo de medios coercitivos para asegurar la asistencia del personal a eventos como los señalados, origina, en los usuarios del sistema de educación, mecanismos de ajuste emocional tales como la agresión, el negativismo, la proyección y otros más, realidades que incluso, pueden provocar conflictos entre la empresa y el trabajador.

El binomio productividad-actualización pierde vigencia. El personal forzado a incursionar por el terreno de la actualización, lejos de orientar su conducta a niveles de mayor eficiencia, tiende a comportamientos conflictivos.

4.6. Desconexión entre el sistema de remuneración y los sistemas de escalafones y capacitación o desarrollo

Con inusitada frecuencia, la orientación de las tareas de educación permanente se aleja de perspectivas específicas para asegurar que a todo incremento de capacidad y de conocimiento se siga un aumento en el salario y/o en las prestaciones.

El estímulo necesario para orientar los motivos de la conducta hacia niveles de perfeccionamiento, se frustra en la medida en que los usuarios de la educación permanente no encuentran un beneficio tangible derivado del esfuerzo realizado.

4.4 Lack of resources for paying for the continuing education task

Modernity's impact on the degree of mercantile competition among businesses, product diversification, and the society's access to consumption, particularly to expanded consumption, oblige the operation of budgets in which an important volume of finances intended for the updating an development of workers and supervisors is seldom contemplated.

In most legislation in the world there has been a concern for the incorporation of legal mechanisms governing capacitation as an obligation and as a right. However, because all updating is not followed by an immediate transformation of results, encouragement of such programs only involves a minimum of the human resources located in the heart of an organization.

In addition, the impact of inflationary mechanisms, and the race of wages, salaries, and benefits with the high cost of living force a large number of persons to dedicate their budgets to satisfaction of needs quite remote from the updating of knowledge. Add employers' budgetary limitations to workers' lack of economic resources for defraying the cost of updating themselves and you create a vicious circle, in which knowledge is not updated due to a lack of financial resources, and resources are not increased because of a lack of knowledge updating.

4.5 Imposition of the task of updating through labor relations

From what can be seen up to now, organizations and institutions opt for encouragement of the task of updating among their human resources, resorting to the strategy of not sensitizing potential users in advance, and the task is imposed on their personnel of compulsory attendance of teaching or development events, under cover of the obligation of the capacitation task. Facilitating said activities of the users during working hours is offered as the motivation.

The employment of coercive means to assure personnel attendance at such events produces mechanisms of emotional adjustment, such as aggression, negativism, projection, and others among the users of educational systems, and these might provoke conflicts between the firm and its workers.

The binomial of productivity-updating ceases to operate. Personnel forced to journey through the updating field, far from orienting their behaviour at levels of greater efficiency have a tendency towards antagonistic behavior.

4.6 The disconnection betwden the remunerative system and the seniority list, and capacitation or development systems

With unusual frequency the orientation of permanent education tasks becomes separated from specific prospects for assuring that every increase in capacity and knowledge is folloged by an increase in wages and/or benefits.

The necessary stimulus for orientation of behavior motives toward levels of improvement are frustrated to the extent that users of permanent education do not find a tangible benefit derived from the effort made.

Ya se enunció el grave problema de las limitaciones presupuestales para alentar las actividades de la educación permanente. Ese problema se relaciona también con el que ahora abordamos. La rigidez de los escalafones, la ausencia de procedimientos idóneos y operantes que aseguren el servicio civil de carrera o la promoción de empleados a nivel institucional en el terreno del escalafón, encuentra, por diversas circunstancias de carácter legal, una serie de obstáculos. Además, como no existe la conciencia, o por lo menos la evidencia de que el saber vale por sí mismo y genera al final del proceso nuevas oportunidades, el individuo se resiste a aventurarse en actividades de beneficios dudosos; así, la resistencia a formar parte de los mecanismos de educación continua dentro de las organizaciones, engendra, bajo diversas circunstancias, factores adicionales de resistencia.

Si al esfuerzo necesario para participar en los eventos citados, se aúnan el sacrificio de tiempo y el requerimiento de esfuerzo adicional ajeno a las labores propias dentro de la organización, sin la oferta del estímulo correspondiente, los mecanismos de motivación entran de nueva cuenta en crisis.

Por todo lo anterior, conviene precisar que el individuo prefiere permanecer en el status quo en el que se satisfacen sus necesidades de seguridad.

4.7. Inseguridad para satisfacer la necesidad de nuevas experiencias

Los usuarios de los sistemas de educación continua deben tener conciencia de las posibles implicaciones de su capacitación y desarrollo. Aunque es cierto que conocen plenamente la realidad de la institución a la que pertenecen y que saben que no a toda capacitación corresponde una movilidad en el puesto, que no necesariamente van a percibir más ingresos por participar en la actualización para un mejor servicio a la empresa, también es connatural en el ser humano cierta resistencia a las posibilidades de cambio.

La modificación de horarios, la transformación de rutinas, la alteración de un status quo, la posible vinculación anímica con individuos pertenecientes a distintas unidades operativas, son otros aspectos sobre los que conviene reflexionar en la creación de mecanismos de motivación para los usuarios del sistema que nos ocupa, como ya se apuntó.

4.8. Resistencia al cambio

Los miembros de las organizaciones han asimilado una serie de vivencias que se desploman en la relación capacitación-cambio. El cuestionamiento de conocimientos adquiridos y aplicados incluso durante largos periodos, aparte de la inseguridad mencionada en el inciso anterior, abre posibilidades al sujeto para oponerse al cambio. Desde el punto de vista de la comunicación, el cambio incide directamente a través de la información. Al estructurar los datos y al ordenarios con referencia a un fin de innovación, toda vez que es uno de los aspectos esenciales de la educación permanente, el cambio hace concebir planteamientos irreversibles de resistencia.

Por otra parte, la educación continua se asocia a estrategias de cambio organizacional de manera tal que por lo menos en la actualidad, el hombre, por naturaleza, se resiste a aprender a pensar como agente del cambio. Si a esos hechos se añaden los consignados por Grossman en el sentido de que las organizaciones son generalmente víctimas del cambio por el impacto de la economía tanto local como internacional, no se puede considerar el cambio como una cuestión de supervivencia, ni tampoco afirmar que todo cambio es, necesariamente, factor de mejoría.

The serious problem of budgetary limitations on the encouragement of permanent education activities has already been referred to. That problem is related to the one we are now taking up. The rigidity of seniority lists, the absence of suitable and operative procedures assuring career civil service, or the promotion of employees at the institutional level in the field of the seniority list run up against a series of obstacles because of various legal circumstances.

Further, as there is no awareness or, at least, evidence that knowledge is valued for itself and produces new opportunities at the end of the process, the individual resists adventures in activities of doubtful benefit. Thus, resistance to forming a part of the continuing education mechanisms within an organization engenders additional factors of resistance under various circumstances.

If the effort required for participation in said events is added to the sacrifice of time and the need for additional efforts foreing to work itself within the organization, without an offer of a stimulus corresponding thereto, the mechanisms of motivation find themselves in crisis again.

Therefore, it should be made clear that the individual prefers to remain in the status quo where his security needs are satisfied.

4.7 Insecurity towards satisfaction of the need for new experiencies

Users of the continuing education system should be made aware of the possible implications of their capacitation and development. Although it is certain that they are well acquainted with the realities of the institution to which they belong, and they know that job mobility does not correspond to all capacitation, and that they are not going to receive necessarily more income through participation in updating for better service to the company human, beings likewise exhibit a certain inherent resistance to the possibility of change.

Schedule changes, transformation of routines, alteration of the status quo, and the possible psychic relation with persons belonging to different operational units, are other aspects it is advisable to reflect on in the creation of motivation mechanisms for users of the system we are dealing with, as already has been stated.

4.8 Resistance to change

Organization members have assimilated a series of personal experiences that collapse in the capacitation-change relation. The questionnaire about knowledge acquired and applied inclusively during long periods, besides the insecurity referred to in the preceding Section opens possibilities for the subject to oppose the change. From communication of the point of view, the change has direct bearing through information. In structuring the data and putting them in order with reference to an innovation purpose, as it is one of the essential aspects of permanent education, the change causes the comception of irreversible bases for resistence.

On the other hand, continuing education is associated with strategies of organizational change, so that, at least at the present time, man naturally resists learning to think as an agent of change. If you add to those facts the facts stated be Grossman, in the sense that organizations are generally victims of change from the impact of local and international economy, change can not be considered to be a question of survival, and neither can it be asseted that every change is, necessarily, a factor for improvement.

Las realidades en la vida de los negocios y de las instituciones, evidencian que, a pesar de los cuidados que se tomen para emprender innovaciones, éstas generan fuertes dosis de tensión, ansiedad y, en ocasiones, hasta angustia.

5. IMPULSORES PARA EL USO DE SISTEMAS DE EDUCACION CONTINUA

5.1. Sin educación continua no hay desarrollo

La educación permanente es un quehacer que compete a todos ya que sin educación continua no hay desarrollo. El impacto de la vida moderna ha dejado su huella en los sistemas de enseñanza-aprendizaje, sobre todo en los últimos 10 años. La transformación sustancial de los sistemas educativos formales en los países en vías de desarrollo, ha transformado también el basamento de información, formación e incremento de aptitudes específicas.

El esquema tradicional de enseñanza-aprendizaje, simultáneo a la motivación derivada de mecanismos coercitivos, ya no es capaz de transformar la conducta de quienes participan en el proceso educativo.

Las instituciones superiores de cultura, después de la década de los sesentas, confrontaron, cada vez con mayor intensidad, el grave fenómeno de la obsolescencia del conocimiento, agudo problema del que ya no se puede escapar. El impacto de la ciencia, el arte, la cultura, la urbanificación y los desequilibrios en el ordenamiento de la población, el desarrollo de las ciudades y el desequilibrio económico de las zonas rurales, han puesto en crisis los sistemas tradicionales, primero de la universidad medieval, luego de la universidad napoleónica y, finalmente, de la universidad moderna.

Los planes y programas de estudio que integran los currícula deben cambiar a la velocidad adecuada, si se pretende responder con acción y resultados a las necesidades del mundo contemporáneo.

La tesis de la Aldea Global postulada por Marshall McLuhan, donde cada centro de población se convierte en un sistema cautivo de información, comunicación, formación y estilo de vida de acuerdo con patrones y arquetipos, empieza a modificar el rostro de los países no desarrollados, y ha transformado en buena medida las estructuras de los países industrializados.

La instrucción es una actividad fundamental del género humano y en la medida que una sociedad se industrializa y moderniza, la educación, la capacitación, la formación y la comunicación social se van diferenciando progresivamente, se hacen más complejas y se vinculan a otros aspectos de la sociedad.

La educación se hace más necesaria en la actual economía y se llega cada vez más estrechamente a ella como instrumento mediador entre la demanda y la oferta de mano de obra. La competencia general y específica ha originado dos corrientes: un enciclopedismo incipiente alojado en la generalización, y una corriente, también creciente, de alta especialización. En ambos sentidos, los usuarios de los sistemas educativos requieren en forma directamente proporcional, mayor información, un grado más alto de formación, pero, sobre todo, un desarrollo más intensivo de capacidades, habilidades y aptitudes específicas para el desempeño eficiente y eficaz de una ocupación y para el cabal cumplimiento de los objetivos que las organizaciones sociales les confieren.

The realities of business and institutional life disclose that, in spite of the care taken in starking innovations, these create strong doses of tension, anxiety, and, on occasions, even anguish.

5. IMPULSORS TO THE USE OF CONTINUING EDUCATION SYSTEMS

5.1 There can be no development without continuing education

Continuing education is everybody's task, as there can be no development without continuing education. The impact of modern life has left its mark on the teaching-learning systems, above all during the last 10 years. Substantial transformation of formal education systems in the developing countries has also changed the foundation of information, and the formation and growth of specific aptitudes.

The traditional scheme of teaching-learning, simultaneously with motivation derived from coercive mechanisms, is no longer capable of transforming the behavior of those who participate in the educational process.

Higher, cultural institutions, after the decade of the sixties, face with greater and greater intensity, the serious phenomenon of the obsolescence of knowledge, a thorny problem from which there is now no escape. The impact of science, art, culture, urbanization, disequilibria in population order, development in the cities, and the economic disequilibrium in rural zones, have brought crisis to traditional systems, first to the medieval university, then to de Napoleonic university, and, finally, to the modern university. Curricula study plans and programs should change at a suitable speed, if it is sought to respond by action and results to the needs of the contemporary world.

Marshall McLuhan's thesis of the Global Village, in which each population center is converted into a captive system of information, communication, formation, and life style, in accordance with patterns and archetypes, begins to change the complexion of the underdeveloped countries, and has changed the structures of industrialized countries in good measure. Instruction is a fundamental activity of humankind and to the measure that a society becomes industrialized and modernized, education, capacitation, formation, and communication begin progressively to differentiate, become more complex, and attached to other aspects of society.

Education becomes more necessary to the present economy and it comes closer and closer to it as an instrument of mediation between labor supply and demand. Two currents have been created by general and specific competition: one, incipient encyclopedism is located in generalization, and there is also a growing current of high specialization. In both senses, users of educational systems require in direct proportion more information, a higher grade of formation, but, above all, a more intensive development of specific capacities, abilities, and aptitudes for the efficient performance of an occupation and the exact compliance with the objectives set for them by social organizations.

5.2. La educación continua en la Aldea Global

No podemos concebir sistemas educativos sin objetivos claramente vinculados al desarrollo económico de los países, como tampoco podemos entender el sistema educativo aislado de los demás sistemas que componen e integran el panorama de la sociedad moderna. Es en ese sentido que la Aldea Global que postula McLuhan empieza a cobrar realidad en todas las latitudes del planeta. La Aldea Global frente a la Aldea Tribal representa el acceso de los grandes centros de población a una intensa y permanente conexión con los medios de comunicación colectiva, así se abren accesos a la educación continua.

Los sistemas educativos de ninguna manera escapan al impacto de la modernidad ni al influjo de la Aldea Global. Las nuevas generaciones disponen de caudales de información cada vez más amplios, más especializados, aunque quizás menos profundos debido al nivel de la divulgación y de la difusión. En ese sentido el hombre moderno no puede escapar a un afán enciclopédico, como tampoco puede marginarse de una necesidad de especialización; es ahí donde el sistema educativo formal ha entrado en una disyuntiva fundamental: optar por métodos, sistemas y procedimientos para formar generalistas, o bien, escoger el camino de la especialización. Entre ambos, la educación continua es opción y realidad al mismo tiempo.

Conviene reflexionar de manera simultánea sobre la transformación sustancial de los métodos y sistemas para optimizar el proceso de enseñanza-aprendizaje. Del lector tradicional de la universidad del medioevo al apoyo de la imprenta como recurso repetidor, transcurrieron cinco siglos. Del impacto de la letra impresa a la crisis de conciencia derivada del enciclopedismo francés, el lapso fue menor; de ahí a la revolución industrial el tiempo acortó su valor específico y en estos tres lapsos mencionados, el impacto de la educación ha sido evidente.

En la universidad medieval, el usuario del sistema educativo formal asimiló más información que formación y desarrollo; su motivación no es otra que la represión académica. En la universidad decimonónica el individuo empezó a cobrar conciencia del vínculo indisoluble que hay entre lo estudiado y la realidad económica de los países. A principios del siglo, las instituciones de educación superior volvieron a sacudirse para recomenzar el ciclo de partida: generalización contra especialización. Las últimas cinco décadas han sido prolijas en evidenciar la transformación de los centros educativos de nivel superior. Tal parece que la universidad retoma el mismo fenómeno del Renacimiento: un estallido vigoroso en el desarrollo del arte, la ciencia y la cultura.

Al principio de la década pasada la opción fue muy clara, ya no era problema de especialización o generalización, sino algo más profundo: la actualización permanente.

5.3. Impulsores indirectos de la educación continua

En nuestro medio, la educación continua aparece cuando se generaliza la crisis en los sistemas de educación superior. Casi al mismo tiempo se emprenden reformas estructurales en los sistemas de educación elemental. Las casas editoriales, los programadores de radio y televisión, los administradores de medios de comunicación colectiva han advertido en los receptores tendencias que favorecen por sí mismas el uso intensivo de tecnología de educación permanente. De entre ellas conviene destacar las siguientes:

5.2 Continuing education in the global village

We are unable to conceive of educational systems without objectives clearly linked to countries' economic development, nor can we understand an educational system isolated from the other systems making up and integrating the panorama of modern society. This is the sense in which the Global Village, postulated by McLuhan, begins to have reality in all latitudes of the planet. The Global Village, in the face of the Tribal Village, represents access by the large population centers to an intensive and permanent connection with collective means of communication, thus opening access to continuing education.

By no means do educational systems escape the impact of modernity or the influence of the Global Village. The new generations dispose of more and more ample quantities of more specialized information, perhaps less profound due to its disclosure level and diffusion. In this sense it is impossible for modern man to escape an encyclopedic zeal as neither can be stand apart from the need for specialization. This is where the formal educational systems has entered into a fundamental dilemma: to opt for method, systems, and procedures for the formation of generalists, or, rather, to select the specialization route. Continuing education among both of them is both an option and a reality.

One should reflect at the same time on the substantial tranformation of the methods and systems for optimization of the teaching-learning process. Five centuries passed from the traditional lector of the medieval university to the support of printing as a repeating resource. A smaller period passed between the impact of the printed word and the crisis of conscience derived from French encyclopedists. From thence to the industrial revolution time cut down its specific value, and the impact of education has been evident in those three periods.

The user of the formal educational system assimilated more information than formation and development at a State University —his motivation is none other than academic repression. At the nineteenth century university the individual began to become aware of the indissoluble bond between what is studied and a country's economic realities. At the beginning of this century higher educational institutions began again to arouse themselves to begin anew the cycle of where they began: generalization against specialization.

There has been ample evidence in the last five decades of the transformation of higher level educational centers. It would appear that the university is again taking up the same phenomenon as in the Renaissance: a vigorous outburst in the development of art, science, and culture. The option was quite clear at the beginning of the last decade — it was no longer a problem of generalization or specialization, but something more profound — permanent updating.

5.3. Indirect impulsors of continuing education

In our medium continuing education appears when the crisis of higher education systems becomes generalized. Almost at the same time structural reforms are undertaken in elemental education. Publishing houses, radio and television programmers, the managers of collective communication media have noticed tendencies in their receivers favoring by themselves the intensive use of the technology of permanent education. Among them it is advisable to underline the following:

- Tendencia de los receptores a economizar tiempo, dinero y esfuerzo para mantenerse informados.

- Incremento de la tendencia al consumismo, considerando entre los bienes y servicios comercializados los de carácter cultural. Cabe advertir que esta tendencia se limita a las clases alta y media.

- Generalización de arquetipos de conducta que vinculan la cultura como símbolo de prestigio y posición social.

- Explotación de la sed de conocimientos accesibles en función de tiempos breves, precios bajos y diversidad de tópicos de interés.

- Inclusión de actividades culturales combinadas con aspectos de relaciones públicas para orientar y aumentar la proyección de imagen.

- Imitación extralógica de modelos desescolarizados para optar a nuevas fuentes de información.

Si bien es cierto que esas tendencias no son ideales para el desarrollo idóneo de los sistemas de educación continua, también resulta válido postular la hipótesis de que dichas tendencias pueden aprovecharse con ventaja, si se integran mecanismos de motivación que formen la convicción de que la educación permanente puede ser fuente de beneficios nuevos. Para que todo lo anterior sea válido, la educación continua debe tener rigor científico, seriedad académica, calidad y profundidad de información y, sobre todo, reportar beneficios tangibles a quienes hacen uso de ella.

Por otra parte, como el fenómeno de la educación continua, según la entendemos ahora, empezó hace algunos años, la casi totalidad de egresados de los centros de educación superior son usuarios potenciales, por lo que al conocerla como filosofía, como método o como propósito, tendrán motivos, sobre todo si se los inducen, para desearla a corto plazo.

Además, las generaciones citadas fueron formadas para la realidad económica específica de un país en vías de industrialización y como la tendencia industrializadora se ha generalizado, da ahora una necesidad de solución inaplazable. Por un lado, el cambio de trabajo de un individuo le lleva a inquietudes que lo orillan a buscar rápidamente la información, a todas luces indispensable, para su nuevo puesto. Para quienes llevan un lapso considerable en un puesto determinado, el conocimiento de nuevas opciones puede ser punto de interés para incursionar en la actualización, como consecuencia de las tendencias que hemos enunciado.

Por otro lado, la modificación de las estructuras del mercadeo, la intensificación del mercado de valores, los cambios de las condiciones de competencia entre las empresas mercantiles y el elevado costo de la autosuficiencia por medio de la capacitación en el seno mismo de las organizaciones, abre otro sendero para impulsar la educación permanente, siempre y cuando se sigan las reglas mínimas de una motivación intensiva, persuasiva y eficiente.

6. PROPOSICION DE APOYOS A LA INSTITUCIONALIZACION DE LA EDUCACION PERMANENTE

6.1. Conceptualización

La institucionalización consiste en la planeación, estructuración y guía de organismos nuevos o reconstruidos dedicados a inducir

- A tendency on the part of receivers to economize time, money, and effort in order to keep informed.

- An increase in the trend towards consumerism, considering things of a cultural nature among commercialized goods and services. It is to be understood that this trend is limited to the middle an upper classes.

- A generalization of behavior archetypes linking culture as a symbol of social prestige and position.

- An exploitation of the thirst for accessible knowledge in terms of brief time, low price, and the diversity of topics of interest.

- The inclusion of cultural activities in combination with aspects of public relations in order to orient and increase the proyection of an image.

- An extralogical imitation of descholasticized models in opting for new sources of information.

If it really is certain that these are not ideal tendencies for the suitable development of systems of continuing education, it is also a valid supposition that said tendencies can successfully be taken advantage of, if motivation mechanisms are formed that bring a conviction that permanent education can be a source of new benefits. For all of this to be valid, continuing education should assume scientific rigor, be academically serious, possess quality and depth of information, and, above all, obtain tangible benefits for persons making use of it. On the other hand, since the continuing education phenomenon, as we now understand, began only 10 years ago, almost all of the graduates from centers of higher education are potential users, and for this reason, whether they learn of it as philosophy, a method, or a proposal, they will have reasons for desiring it in a short time, above all if there is an unducement.

Further, these student generations were formed for the specific economic reality of an industrially developing country and, since the trend to industrialization has become generalized, it now produces a need for solutions which can not be put off. On the one hand, changes in a person's work create anxieties causing him soon to seek information, in any event, for his new position. Persons who have spent a considerable time in a certain position may find that the knowledge of new options can be a point of interest for an incursion into updating, as a result of the consumer trends we have referred to.

On the other hand, changes in marketing characteristics, intensification of the stock market, changes in the conditions of competition between commercial companies, and the high cost of self-sufficienency in the heart of the organizations themselves, open another path for fostering permanent education, provided the minimum rules for intensive, persuasive, and efficient motivation are followed.

6. A PROPOSAL FOR SUPPORT OF INSTITUTIONALIZATION OF PERMANENT EDUCATION

6.1 Conceptualization

Institutionalization consists in planning, structuring, and guiding new or reconstructed organizations dedicated to inducing changes cambios de valores y renovación de funciones y tecnologías físicas o sociales, mediante el establecimiento, impulso y protección de nuevas relaciones normativas y patrones de acción. A partir de esta aproximación conceptual, la educación permanente es estrategia para la institucionalización y es, asimismo, objeto de institucionalización.

6.2. Institucionalización y Educación Continua

La educación continua es estrategia de o para la institucionalización en la medida que se constituye como instrumento y herramienta de formación, información, capacitación y desarrollo de recursos humanos en el seno de las empresas y organizaciones. Conviene advertir que además facilita la comunicación de innovaciones; alienta la adopción de métodos, sistemas y procedimientos mejorados; permite un ensanchamiento de las redes y canales de comunicación al lograr la interactuación e interrelación de los usuarios de dicha educación. Como efectos colaterales tiene la formación de grupos de trabajo homogeneizados por el establecimiento de códigos que se derivan de los nuevos conocimientos adquiridos; permite la incorporación de sistemas de relaciones humanas durante el desarrollo de los eventos de educación continua; propende al intercambio informal de criterios y a la confrontación de puntos de vista sobre la organización.

Decimos que la educación permanente es objeto de institucionalización en tanto que, como modalidad de los sistemas educativos, puede ser agente de cambio y al mismo tiempo instrumento que evita el rezago y la obsolescencia de quienes tienen bajo su responsabilidad la operación de sistemas de enseñanza-aprendizaje.

La Organización de las Naciones Unidas ha alentado este quehacer en ambos sentidos y bajo muy diversas modalidades. El apoyo para fomentar acciones específicas de desarrollo económico, en opinión de los expertos de la ONU, se vincula directamente con mecanismos y estructuras de la educación formal y desescolarizada. En la Conferencia Internacional auspiciada por la ONU para definir la Función de la Administración Pública en el Establecimiento de un Nuevo Orden Económico y Social, realizada en agosto de 1975, se concluyó sobre la importancia de institucionalizar mecanismos de capacitación y desarrollo de recursos humanos como opción para racionalizar el aparato gubernamental de los Estados. Sería prolijo abundar sobre la importancia que el organismo internacional citado ha dado a la educación y sobre sus repercusiones en el progreso de los estados miembros.

6.3. Ventajas de la institucionalización con apoyos multinacionales

Los expertos en desarrollo de la ONU se han inclinado por la institucionalización de la educación permanente en otro sentido, porque permitirá:

a). Difundir tecnologías que orienten eficiente y eficazmente al desarrollo de empresas, organismos e instituciones, tanto del sector público como del privado.

b). Incorporar a las organizaciones nuevas relaciones normativas y patrones de acción, adoptados piramidalmente con la participación activa de los recursos humanos involucrados en los planes y programas de formación y actualización.

c). Contribuir en la lucha contra la resistencia al cambio y operar tareas de mejoramiento técnico y administrativo, a través de los procesos optimizados de enseñanza-aprendizaje destinados a los adultos, ya sea en calidad de trabaja-

in values and the renewal of physical or social functions and technologies, through the establishment, stimulus, and protection of new normative relations and action patterns. Starting from this conceptual approximation, permanent education is an institutionalization strategy and is, likewise, the object of institutionalization.

6.2. Institutionalization and continuing education

Continuing education is a strategy of or for institutionalization in the measure that it is set up as an instrument and tool for the formation, information, capacitation, and development of human resources in the bosom of firms and organizations. It should be mentioned that, in addition, it facilitates the communication of innovations; encourages the adoption of improved methods, systems, and procedures; it allows a widening of communication channels and networks by achievement of the interaction and interrelation of the users of this education. As collateral effects, there is the formation of homogenized work groups through the establishment of codes derived from the new knowledge acquired; it permits the incorporation of human relations systems during the development of the events of continuing education; it has a tendency to an informal exchange of opinions and the confrontation of points of view about the organization.

We stated that permanent education is a subject for institutionalization, as long as, as a modality of educational systems, it can be an agent for change and, at the same time, an instrument avoiding the remaindering and obsolescence of those who are responsible for the operation of teaching-learning systems.

The United Nations Organization has encouraged this task in both senses and under quite different modalities. The support for fostering specific actions of economic development, in the opinion of the UN experts, is joined directly to the structures of formal and descholasticized education. At the International Conference held in August 1975 under UN auspices to define the Role of Public Administration in the Establishment of the New Economic and Social Order, a conclusion was reacher on the importance of institutionalizing human resources capacitation and development mechanisms as an option for rationalization of states' gobernmental apparatus. It would be tedious to carry an about the importance given to education by this international Organization and of its repercussions on the member states.

6.3 Advantages of institutionalization with multinational support

The experts at the U.N. have inclined towards institutionalization of permanent education in another sense, but it would allow:

a) The disemination of techonology, efficiently and efficaciously orienting public sector as well as private sector firms, agencies, and institutions.

b) Introduction of new standars of relations and action patterns, pyramiding them with the active participation of the human resources involved in formation and updating plans and programs.

c) Contribution to the struggle against the resistance to change, performing technical and administrative tasks, through optimized teaching learning processes for adults, whether in the dores, ya sea como supervisores o funcionarios de mandos intermedios.

d). Fomentar la intención y las conductas que implican deseo de acceso a información técnica y administrativa especializada, sistematizada y actualizada en función de necesidades específicas detectadas en el seno de las organizaciones.

e). Propender a la generación de nuevas pautas de conducta laboral que ayuden a transformar actitudes y aptitudes para cuando los usuarios del sistema de educación continua salgan formalmente de él y regresen a sus centros de trabajo con una motivación distinta.

f) Apoyar la complementariedad de los recursos humanos usuarios de los sistemas de educación permanente para que asimilen información, adquieran nuevas inclinaciones por [illegible] enterados de la modernidad y generen tareas de mejoramiento organizacional en el seno de las instituciones.

g). Crear esquemas de vinculación entre empresa, trabajadores y supervisores, derivados de la aplicación de los modernos sistemas de enseñanza-aprendizaje en los cuales se destaca, de manera considerable, la participación dinámica de los integrantes del grupo.

Se pueden evitar, en gran medida, la dispersión de esfuerzos, la duplicación de investigaciones orientadas al mismo propósito, la erogación de presupuestos y otra serie de situaciones colaterales, si a través de un organismo internacional como la UNESCO, se establecen sistemas de cooperación internacional, bilaterales o multinacionales, con el fin de compartir costos para sufragar investigaciones y operar programas cuyos resultados se pueden aprovechar indistintamente en diversos países, merced a una planeación conjunta de estrategias y a una detección común de necesidades.

Los esfuerzos que la UNESCO ya ha realizado en este sentido pueden incrementarse en intensidad y profundidad, mediante foros internacionales de discusión como éste donde se postula la necesidad y se establecen los mecanismos iniciales para configurar un vasto sistema de interacción en beneficio de los participantes. Además, el liderazgo intelectual que ejerce la entidad identificada con las siglas de UNESCO allanará, en un considerable número de países, la resistencia a la educación continua y ayudará a entenderla como un mecanismo recomendable para acceder a nuevas estrategias de desarrollo intelectual vinculado al proceso económico y social.

6.4. Movilización Social y Educación Continua

Entendemos el término de movilización social, con Antonio Menéndez, como el conjunto de técnicas que aseguran perspectivas para que las personas y las instituciones participen en tareas globales tendientes a la consecución de metas fijadas en un país determinado y con un propósito dado de participación, acción y resultados.

En México, como en otros países en vías de desarrollo, urge crear conciencia sobre las necesidades de educación permanente para que se convierta en acción y, asegurando un mecanismo persuasivo, se proporcionen sistemas operativos que respondan a la satisfacción de las necesidades enunciadas. En este sentido la movilización social desempeña una función estratégica.

La educación permanente para consumarse, requiere orientar los motivos esenciales que inducen la conducta del ser humano hacia la satisfacción de sus necesidades de información. Esto implica

status of workers, or as supervisors and midmanagement officers.

d) Fostering of intentions and behavior implying a desire for access to systematized and updated specialized technical and administrative information, in function of specific needs detected in the bosoms of the organizations.

e) A Tendency towards the creation of new guide lines aiding in transformation of attitudes and aptitudes for the time when continuing education system users formally leave it to return to their centers of work with a different motivation.

f) Supporting the complementarity of the human resource users of the permanent education system so they assimilate information, acquire new inclinations towards being well-informed about modernity and create organizational improvement tasks in the bosom of their organizations.

g) Creation of schemes for bonds between the company, the worker, and the supervisor, derived from application of new teaching-learning systems in which the dynamic participation of the members of the group is greatly emphasized.

A dispersal of forces, duplication of research oriented to the same ends, disbursement of budgets, and another series of collateral situations can be avoided, if bilateral or multinational international cooperation systems are established through an international agency like UNESCO, for the purpose of sharing expenses to pay for research and operate programs whose results can be enjoyed without distinction in many countries, thanks to joint planning of strategy and common detection of needs.

The efforts UNESCO has already put out in this regard can be increases in intensity and in depth, through international discussion forums, like this, where the need is postulated and the initial mechanisms are set up for configuration of a vast system of interaction to the benefit of its participants. In addition, the intellectual leadership exercised by the entity identifies by UNESCO'S acronym will smooth out the resistance to continuing education in a considerable number of countries and will assist in its being understood as an instrument to be recommended for acceding to new strategies of intellectual development linked to economic and social process.

6.4 Social mobilization and continuing education

Our understanding of the term social mobilization is that of Antonio Menendez, as a group of techniques assuring the prospect that persons and institutions will participate in global tasks tending to achievement of set goals in a certain country with a given proposal of participation, action, and results.

In Mexico, as in other developing countries, creation of an awareness of the need for permanent education is urgently needed, so that it can be converted into action assuring a persuasive mechanism and providing operative systems responding to satisfaction of the needs referred to. In this sense social mobilization performs a strategic function.

For consummation of permanent education, orientation of the essential motives inducing human behavior towards satisfaction of its information needs is required. This implies creation of mecha

crear mecanismos de movilización social, adoptar medidas convincentes que faciliten la tarea tanto de quienes promueven este tipo de educación, como de quienes lo usan.

Si alentamos sin método la educación continua corremos el grave riesgo de mutilar su esencia, pero aún más grave sería exponerse a condenar al fracaso la operación de sistemas integrados de educación permanente, si no existe la capacidad de dar orientación certera a la serie de eventos que caen dentro del concepto que nos ocupa.

Los planes y programas que integran los currícula para educación permanente, deben obedecer a técnicas probadas de enseñanza-aprendizaje para adultos, en especial para profesionales. Pasar por alto esto, significa destinar al fracaso los esfuerzos realizados, comprometerse con el dispendio de recursos, tiempo y esfuerzo de quienes, en su afán por actualizarse, sólo cobran conciencia de un desaliento y de un profundo desencanto que habrá de repercutir con impacto multiplicador entre los usuarios potenciales del sistema.

En sentido contrario a los riesgos apuntados, si se opta por mecanismos creativos, incluso audaces, que vinculen la movilización social y la educación continua, se creará una conciencia nacional sobre su origen y destino. Las técnicas probadas de movilización social vincularán a los sectores público y privado para emprender, con eficiencia y eficacia, un programa de movilización tal, cuyos efectos incidan a muy corto plazo en la solución de los graves problemas que confrontamos.

Si las razones anteriores no fueren suficientes para apoyar la institucionalización de la educación continua mediante procedimientos de movilización social, pueden aducirse tres razones más para obrar en consecuencia.

- La primera se funda en que, aunque parezca una verdadera perogrullada, lo primero que se necesita para resolver un problema es tener conciencia de que dicho problema existe. La movilización social es un camino para asegurar respuestas intencionalmente deseadas.

- La segunda se basa en una comparación de tiempo. Si consideramos, mediante una operación aritmética, la distancia de aquí al año 2000 nos damos cuenta que es la misma que nos separa de 1956. Si retrocedemos mentalmente al año 1956, parece que fue ayer, sus recuerdos están aún frescos, la relatividad del tiempo nos acerca con una proximidad muy cercana. Ver hacia el año 2000 ofrece idénticas circunstancias. Si en ese año carecemos todavía de tecnología para ofrecer satisfacción plena a las masas con acceso a la información, si todavía no hay opciones de desarrollo y carecemos de oportunidades para cumplir cabalmente la dimensión de una vida humana digna, sintetizadas en casa, vestido, sustento, salud y asomo a la cultura, los resultados serán imprevisibles. Para entonces, las técnicas de movilización social para institucionalizar la educación permanente deberán ofrecer expectativas de singular importancia. Los que nos hemos comprometido con interés en el desarrollo de la educación continua, tenemos la convicción de que ella es una opción de la modernidad para asegurar resultados.

- La tercera razón es más obvia. Por lo que hasta el momento puede apreciarse, ¿qué otras opciones hay para una actualización a fondo del conocimiento?; ¿qué otras perspectivas nos ofrece la educación contemporánea, que no sean modalidades de la educación permanente entendida en su entraña

nisms for social mobilization, the adoption of convincing measures facilitating the tasks not only of those promoting this type of education but of those using it.

If we encourage continuing education without method we run the serious risk of mutilating its essence, but it would be more serious to condemn the operation of integrated permanent education systems to failure, if there is no capability for sure orientation of the series of events falling within the concept we are dealing with.

Plans and programs forming the curricula of permanent education should conform to proved teaching-learning techniques for adults, particularly for professionals. Overlooking this mean condemning previous efforts to failure, makes obligatory the wasting of the resources, time, and efforts of those who, in their zeal for updating are aware only of discouragement and deep disenchantment which must have multiple repercussions among the potential users of the system. In the other direction from the risks set out, if creative, including audacious, mechanisms linking social mobilization and continuing education are opted for, a national awareness of its origin and destiny will be aroused. Proved social mobilization techniques will unite the public and private sectors to efficiently and efficaciously undertake such a mobilization program, the effects of which will influence the solutions of the serious problems we are facing.

If the foregoing reasons are insufficient for supporting institutionalization of continuing education through social mobilization precedures, three more reasons can be given for doing so:

- The first is based on the fact that, although it would appear be a true platitude, what is needed first in the decision of a problem is to know that a problem exists. Social mobilization is a way to assure answers that are intentionally desired.

- The second is based on a time comparison. If we consider by arithmetic the time from today to 2000, we will notice it is the same as that separating us from 1956. It seems only yesterday. Its memory is still fresh. Time relativity brings it quite close to us. Looking forward to 2000 presents the same circumstances. If, in that year, we skill lack the technology to give satisfaction to the masses that have access to information, if there are as yet no options for development, and we lack opportunities for completely meeting the dimension of a dignified human life, synthesized in home, clothing, sustenance, health, and a peep at culture, the consequences can not be foreseen. At that time the techniques of social mobilization for institutionalization of permanent education should offer exceptations of great importance. Those of us who have obligated ourselves by an interest in the development of continuing education are convinced that it is a modern option to assure results.

- The third reason is more obvious. From what can be assessed up to now, what other options are there for an updating of awareness in depth? What other prospects are offered by contemporary education that are not aspects of permanent education as understood in its philosophic essence? Where shall

filosófica?; ¿dónde hallará el hombre respuesta a sus sedes básicas de estructuración de tiempo y gratificación por el conocimiento y el saber?; ¿hacia dónde dirigiremos la mirada para encontrar otros caminos que desarrollen a plenitud las actitudes y aptitudes del hombre que ya pronto, dentro de dos décadas, se asomará al siguiente milenio de la historia? La respuesta está en nuestras manos mediante un compromiso en la movilización para lograr la estrategia de institucionalizar la educación permanente, sin la cual no hay desarrollo.

CONCLUSIONES

La aparición de los mecanismos institucionales de educación permanente implica, en nuestro medio, asumir con decisión y entusiasmo la tarea de satisfacer los requerimientos crecientes de este género de quehacer educativo. El amplio espectro de especialización en las diversas ramas de la ingeniería y otras profesiones afines, aunado a la necesaria coordinación de los ingenieros con profesionales de formación muy diversa, nos lleva a postular en el seno de este Congreso las siguientes conclusiones a partir de la ponencia intitulada: Perspectivas para la Motivación e Institucionalización de la Educación Continua en México.

1. Si no hay educación continua o permanente entre los egresados de las instituciones de educación superior, se restringen considerablemente las opciones para un desarrollo económico integral. La ausencia de sistemas de educación continua eficientes y eficaces, obstruye las tareas del progreso en el campo de la ingeniería, dada la proyección social que desempeñan los ingenieros en la planeación, construcción y conservación de obras de infraestructura y también en las tareas vinculadas con los diversos procesos productivos y de prestación de servicios relacionados con la vida económica del país.

2. El quehacer de educación continua es, por lo que hasta el momento puede apreciarse en México, una actividad reciente, la cual no se ha generalizado con la intensidad que las prioridades nacionales demandan, ni tampoco ha sido objeto de reglamentación que comprometa a la eficiencia y a la eficacia.

3. La promoción de actividades de educación continua entre los egresados de los centros de enseñanza superior, se frena de manera evidente por:

a). Falta de conciencia sobre el fenómeno de la obsolescencia del conocimiento;
b). Ignorancia de métodos y sistemas optimizados de enseñanza-aprendizaje;
c). Falta de tiempo para emprender el quehacer de actualización;
d). Carencia de recursos para costear el quehacer de educación continua;
e). Imposición del quehacer de actualización a través de la relación laboral;
f). Desconexión entre el sistema de remuneración y el sistema de escalafones y reconocimientos;
g). Inseguridad para satisfacer las necesidades vitales del individuo;
h). Resistencia al cambio.

4. Resulta urgente la estructuración de un sistema de divulgación y difusión a nivel nacional que permita informar y crear conciencia sobre las ventajas que se derivan de la edu

man find an answer to his basic thirst for structuralizing time and gratification through knowledge and learning? Where shall we look to find other routes fully developing the attitudes and aptitudes of man, who soon, in two decades, will approach the next millenium of history? The answer lies in our hands through an obligation for mobilization to achieve the strategy of institutionalization of permanent education, without which there can be no development.

CONCLUSIONS

The appearance of institutional mechanisms for permanent education implies in our medium the assuption with decision and enthusiasm of the task of satisfying the growing needs of this type of educational job. The broad spectrum of specialization in the various fields of engineering and other related professions, added to the necessary coordination of engineering with professional men with quite different backgrounds, leads us to postulate in the bosom of this Congress the following conclusions from the paper entitled: Prospects for the Motivation and Institutionalization of Continuing Education in Mexico.

1. If there is no continuing or permanent education for the graduates of institutes of higher education, the options for a complete economic development are greatly restricted. The absence of efficient and efficacious continuing education systems obstructus the tasks for progress in the engineering field, given the social projection performed by engineers in the planning, construction, and conservation of works of infraestructure as well as in the tasks linked to different productive processes and the rendering of services related to the country's economic life.

2. The job of continuing education, insofar as it can be evaluated up to now in Mexico, is a recent activity, which has not been generalized as intensely as Mexican priorities demand, nor has it been the subject of regulation requiring efficiency and efficacy.

3. The promotion of continuing education activities among the graduates of centers of higher education is restrained in an obvious manner by:

a) A lack of knowledge of the phenomenon of the obsolescence of knowledge;

b) Ignorance of optimized teaching-learning methods and systems;

c) A lack of time for undertaking the task of updating;

d) A lack of resources for endowment of the tasks of continuing education;

e) Imposition of the task of updating by means of labor relations;

f) A lack of connection between the system of remuneration and the system of seniority lists and recognition;

g) Insecurity in satisfaction of the individual's vital needs; and

h) Resistance to change.

4. The structuring of a system of disclosure and diffusion at the national level which will permit information about and the creation of awareness of the advantages of continuing educa-

cación continua. Para esto se propone emplear mecanismos de movilización social a partir de los cuales participen las instituciones, empresas y organizaciones, tanto del sector público como del privado, con el objeto de vincular la totalidad de los centros de educación continua con las necesidades más urgentes de actualización del conocimiento, comprometiéndolos en la lucha contra la obsolescencia del mismo, y con el deber de institucionalizar reforzadores de conducta que faciliten el acceso a nuevas aptitudes que eleven la calidad de los servicios profesionales.

5. Se deben proponer, mediante las instituciones competentes de cada país, leyes nacionales reglamentarias del quehacer de educación permanente, a través de las cuales se asegure calidad de información, profundidad en la formación y rigor científico, que basadas en la realidad económica, organizacional y social de las instituciones, tutelen y protejan los derechos de los usuarios de los sistemas de educación continua.

6. Intensificar los trabajos de investigación en el campo de la conducta que descubran los verdaderos motivos que inducen al ser humano a usar la educación permanente, y respondan eficiente y eficazmente no sólo a las expectativas y necesidades en la materia, sino además, a la realidad concreta del país.

7. Proponer a la UNESCO la institucionalización de un sistema de convenios bilaterales o multinacionales que alienten el quehacer de la educación continua como parte permanente de los programas, principalmente entre los países en vías de desarrollo y como estrategia para consumar a plenitud el derecho inalineable del hombre, en todas las etapas de su vida, a la educación y a la información actualizada.

tion is urgently needed. The employment of mechanisms of social mobilization is proposed for this, on the basis of which public and private sector institutions, firms, and organizations, would participate for the purpose of linking all of the continuing education centers to the most urgent needs for updating knowledge, forcing them into the struggle against its obsolescence, and with the duty of institutionalizing behavior intensifiers facilitating the access to new aptitudes which will raise the quality of professional services.

5. National laws regulating the permanent education task should be proposed by competent institutions of all countries. Such laws would assure the quality of information, formation depth, and scientific rigor, which, based on the organizational and social economic reality of the institutions, would guide and protect the rights of the users of continuing education systems.

6. Intensification of research work in the field of behavior to discover the true motives inducing human beings to use permanent education, and which would respond efficiently and efficaciously not only to the expectations and needs of the subject but also to the country's concrete needs.

7. Propose to UNESCO institutionalization of a system of bilateral or multinational agreements to encourage the job of continuing education as a permanent part of the programs, principally in the developing countries, as a strategy for full consummation of the inalienable right of man, at all times of life, to updated education and information.

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SESSION 3

GOVERNMENTS INFLUENCE ON CONTINUING EDUCATION

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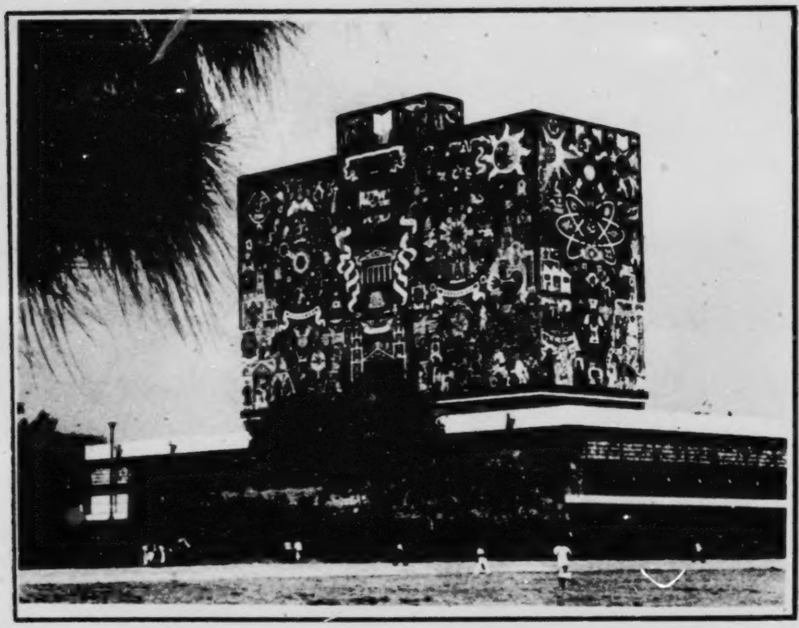
José A. Nieto got his B.S. en Civil Engineering at the National University of Mexico, and his M.S. and Ph.D. degrees at the University of Illinois, Urbana where he was a research assistant and a research associate. He has been a research professor at the Institute of Engineering (Instituto de Ingeniería) and at the Materials Research Center (Centro de Investigación de Materiales) of the National University of Mexico. He was the founder and first director of the Materials Research Center. From 1970 to 1976 he was appointed by the Mexican Government to head the Balsas River Comission (Comisión del Río Balsas), a regional development agency devoted to the Balsas River Basin. Later on he became head of the Graduate Division of the School of Engineering at the National University of Mexico and has just been appointed Director of the Center for Research and Technical Assistance of the State of Querétaro (Centro de Investigación y Desarrollo del Estado de Querétaro).



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SCENES FROM MEXICO

SESSION 4A

GROUP I

PROFESSIONAL SOCIETY PROGRAMS

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In the last few years the professional societies have initiated many activities in the continuing education field for their membership. The members of the various professional societies have been very vocal over the past three years asking serious questions from the various professional society staffs on what they are getting for their dues.

In order to help to overcome this criticism they have begun to offer more member services. The continuing education programs of the various societies have thus increased as they perceive a problem in this area. They are primarily of the live lecture variety and are given throughout the country. Their biggest problem is that they have a large membership scattered over a wide geographic area. They are prime candidates for continuing education utilizing multi-media techniques and in particular video-tape cassette programs. The American Chemical Society is already putting together video tapes in conjunction with MIT through an NSF grant. The Institute of Electrical and Electronic Engineers is beginning to put together a series of video tapes dealing with microprocessors and they should be completed by early fall of 1977.

The professional societies have has some experience with audio tape cassette programs. Societies such as the American Society for Training and Development, IEEE, American Chemical Society and others, have put together audio tapes of some of the main speakers at their various conferences. In addition, several of them have tried to package and market audio tape cassette programs dealing with specific subject areas in their field of specialty. The problem becomes the cost to the membership. Although the membership is large, the interest in any one particular scientific segment is very fragmented and thus the cost per tape is high. In most cases the individual engineer or scientists must individually purchase these items. Several companies have subscribed to this kind of service and have put it in their library, thus making it available to their employees. This has been a somewhat discouraging adventure for several of the societies however, and they are constantly looking for ways of reducing costs to the individual member.

The latest technique that is being used by professional societies with some success is in trying to develop some rapport with the various continuing education divisions of the engineering schools around the country. By forming consortia they have a merketing arm which they do not have to pay for in their overhead cost. In this author's opinion this will increase over the next decade and these professional societies will become co-partners with the universities to serve the engineers and scientists throughout the country. At the present time there is a certain amount of frictio between the two groups, as they feel that each is trying to take over the entire market. This is an impossibility. There is more continuing education necessary than there are resources and manpower by any one single organization to accomplish this objective.

Probably one of the strong points for the professional societies is their ability to evaluate any program Among their various technical groups and organizations within the society they have experts that would tell the university whether or not the information that is being presented is the latest up to date material. This is a plus factor and the universities should be utilizing the professional society more for this evaluation procedure. TheInstitute of Electrical Electronic Engineers is trying to work with the Continuing Engineering Studies Division of the ASEE to accomplish this task.

Multi media package education programs have the potential of providing quality programs for the various local sections of any society around the country. Hardware costs for each individual section seems to be the biggest stumbling block. However, a close working relationship between the professional society and the university or industry in the local area could help reduce this problem. The NSF could support experiments in this area and help determine if it is feasible.

An interesting development in continuing education that effects the professional societies is the increasing emphasis placed on professionals by the various states to continue their education. This is being accomplished by state legislature and the professional groups themselves. A chart, published in a recent issue of the Chronicle of Higher Education, is attached to indicate the current status of such efforts. If these groups are moving in this direction the engineering and scientific societies must ask themselves "Can we be very far behind?" If it comes to pass that the scientific and engineering community moves in this direction the professional societies will play a key role. This will require extensive use of all multimedia techniques to disseminate the information. The number of instructors required to do the job over a widely dispersed constituency, along with the cost and individual time constraints make the typical approaches of workshops, seminars, etc. ineffective.

The professional societies will not be able to finance such an effort alone. The consortia will have to be formed between societies, between the professional society and the universities, and between industrial employers and the societies. A new organizational model for continuing education activities will be needed because of the lack of resources, manpower, and time by any one of the groups mentioned alone.

Vladimir Yackovlev, who is the Chairman of the International Division of ASEE, is a Civil Engineer, educated in Venezuela and the United States. After graduating from the Central University of Venezuela, he came to the United States where he got his M.Sc. degree from the University of Illinois. He returned to his country and began working at his university as an instructor. After getting some experience there he came once more to the U.S., where he obtained his Ph.D. degree at the same university. Very early in his career, Dr. Yackovlev became interested in engineering education and it is in this field where he has become known internationally. After some 40 publications in this field and participating in numerous meetings on engineering education both in his personel capacity as an expert in this field, as well as a representative of his country, he is an active spokesman for engineering education in Latin America. Aside from his duties as Chairman of the International Division of ASEE, Dr. Yackovlev is a Member of the UPADI Committee on Engineering Education on the Panamerican level; a member of the Committee on Education and Training of Engineers of the World Federation of Engineering Organizations and a member of the International Working Group on Engineering Curriculum Design of UNESCO. In his own country - Venezuela - he is the Director for International Affairs of the Venezuelan Society for Engineering Education. He has held various academic positions at his university, being at the present time, the Executive Secretary of the Venezuelan Fund for Research and Personel Development for the Petroleum and Petrochemical Industries.

FINLAND: A NATIONAL PROGRAM

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Summary

Education and know-how are now understood in Finland as the principal resources of the nation. Consequently, extensive high-quality continuing engineering education is an important part of the management of Finnish industry today. The most important educators are professional societies. Universities play a minor role. Continuing engineering education in Finland is economically self-supporting.

The need for and directions of continuing engineering education emerge not only from the present state of the art but increasingly, from a vision of the future. Need analysis is also policy-making. Continuing engineering education helps every scientist and engineer in his professional development to become a maker of this policy, a builder of the future of the nation.

Finland and its engineering manpower

Finland is a highly industrialized country geographically located "at the top of the world". Finland's location compares well with Alaska,both are located between 60° and 70° at the northernhemisphere. The climate in Finland is relatively mild, however, due to the Gulf Stream, which makes widespread agriculture possible in large parts of the country.

Finland has a population of 4,7 million. In average, the country is not densely populated, but there is a heavy concentration of people as well as industry in the south-western part of the country. The beginning of modern industry occurredin Finland in the period from 1860 to 1880. Industry relied heavily on natural resources (mainly forests) until the end of World War II. Export growth was very high (larger than the average growth of GNP) during 1950's and 1960's. After the changes in international trade following the oil crisis of 1973 Finland and its industry are adapting to the situation by increasing the use of education and know-how. At present, Finland's GNP/capita is about 15th largest in the world.

Suomen Teknillinen Seura (The Engineering Society in Finland STS) is the major organization of graduates from technical universities and faculties in Finland. Its membership is over 15 000, including "young members". Total number of graduates, "diploma engineers", in Finland is about 17.000. In 1975, there were 13 500 graduated engineers, 18 000 college engineers and 44 000 higher technicians in the country.

STS' organizational objectives are to take care of the interests of its members, to promote technical sciences, industry and technology, and to contribute to the economic life of the country "for the best of man and his environment". One of the most important ways of fulfilling these aims is continuing education of engineering manpower.

Engineering organizations' continuing education centre (INSKO)

In 1964 STS, together with three other organizations, formed INSKO (Engineering Organizations' Continuing Education Centre). This CE Centre gives about 50 % of all technical continuing education in the country, employers' organizations programs included. INSKO courses have been attended by more than 100 000 participants. INSKO works on a non-profit basis andthe operation is funded by fee income entirely. Occasionally, on project basis, the government may assist with a R & D grant, but there is no substantial subsidy at all.

STS is concerned with all continuing education needs of its membership, and STS thus promotes also other continuing education than that given by INSKO. STS tries to resist a strict division of labour and promotes managerial, economic and legal continuing education, which is essential to tasks outside the purely technical functions. As will be discussed alter, it is more important to set up a goal for the development of engineering manpower than to make surveys of current opinion on those goals. An engineering organization should not only be a channel of information, but a conscious actor with defined social goals in developing the industrial and organizational setting of its members and their work environment.

INSKO operation

The main format used by INSKO is a 2-3 day seminar, but increasingly longer courses (e.g. a half-a-year program in technical management) are offered and they are well received.

INSKO's 29 permanent advisory groups form the basic organization of need analysis. Their combined membership is about 200, 80 % of them from industry.

There are 240 special program planning groups with altogether 1 400 members. Every day, there are more than five planning and need analysis meetings in INSKO. Bulk of this work is voluntary, but usually the meetings take place during work hours.

INSKO has also conducted surveys on traditional faculty specialization areas (electrical and electronics engineering, wood-based industries, construction, mechanical engineering, metallurgy). These surveys covered selected engineering management, industry engineers and research people. Occasionally specialized mail inquiries are used, as well as more intensive R & D on problem areas.

Evaluation of the programs is done mainly by means of questionnaires. Every student is asked to fill in a detailed evalution form, which is then carefully analyzed by INSKO.

Creativity development is a specialty of INSKO. Much original scientific work on creativity development is done within the organization, especially by Dr. Kivikko, who is the only person doctorated on this field in Scandinavia.

A very important part of the operation is setting of the goals for the operation. INSKO's board of directors consists of representatives of the four engineering organizations. They make up the policy and the directions in which INSKO is developed. Thus it can be maintained with good reason that in INSKO people who attend the courses also manage the operation.

INSKO courses are promoted be very selective and specialized mailing lists, but catalogs, publicity in magazines and newspapers and paid advertising is also used.

Average cost per student hour is a little above $ 10. Cost breakdown pattern 1977/78 is as follows:

planning 5 %
promotion 12 %
fees 27 %
salaries 29 %
materials 8 %
meals, meeting rooms 12 %
overhead 6 %

Number of people served was 8 500 in 1977-78. About 15 % of the total engineering manpower (university level) was served. Enrollment distribution according to education background is typically the following:

academic (engineers and others) 30 %
college engineers 30 %
higher technicians 20 %
others 20 %

The program planning occurs according to the subject's requirements, not according to the formal education of the anticipated participants. STS stresses the need for high-level courses and non-technical subjects.

Program instructors come mainly from industry or are private consultants. INSKO's own teaching capacity is very limited. Professional educators and government experts are used to some extent as teachers.

The most important principle in hiring instructors is very simple: the best instructors are hired. Evaluation of different instructors' capacities is made in the planning groups. In this, the course evaluations,which are written after each course by each participant, have proved very helpful. Hiring instructors has not been especially difficult, due to INSKO's dominating position in Finnish technical continuing education.

Continuing education in Finland is given by employers (about 40 %), professional societies and comparable institutions (35 %) and universities. The role of universities is becoming more important in near future. STS supports this trend.

According to STS' long-term goals, its members should participate in organized continuing education a total time of 10 % of their work time .As long a time should be used for personal self-development and study at a person's own time. At this moment, participation in organized continuing education lies on a 3 %-level. The most important factor affecting a person's participation rate has proved to his direct supervisor. STS stresses the importance of continuing education both for a person, and for the people who work for him.

No formal professional development examinations or diplomas are used. Instead, STS recently started consulting a small number engineers (about 15) on their professional development in the future and their corresponding continuing education needs. If a consistent pattern emerges from this experiment, it may lead to a formalization of professional development. Assisting the members in their professional development is the most important task of an engineering organization today.

Hannu Laine

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- present affiliation: Secretary for Education at the National Technical Society of Finland, Helsinki, Finland
- previous experience from foreign service (Finnish Department of Commerce and Industry, Technical Information Service) and R & D in wood-based process industry
- extensive writing in the field of education
- age: 32 yrs.

PROFESSIONAL SOCIETIES AND CONTINUING EDUCATION IN INDIA

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Director
Indian Institute of Technology
India

1. PROLOGUE

> "No matter how much education one has, it is not enough ...... Unless one devotes time and energy to continuing his education, he will quickly drop-out - yet this caution is not prophecy of doom - on the contrary, its aim is to help one see where he fits into the scheme of things and tell him something more to think about and act."

The basic reality for more characteristic than continuity in the context of the growing aspirations in the world has been the evidences which are so visible in many attempts for achieving exponential growth rates in almost everything and verily they have become the norm. The restless surge to seek socially, culturally and economically better environments and the ceaseless probes into new technologies for opening up of ever wider horizons for adventure have led to continuous search for new materials and components to help application in a variety of fields along with introduction of titanic complexes to advance industrial development and enhance productivity. Organized efforts to retrieve new knowledge which is limitlessly exploding in the age of growth of sophisticated nuclear and space programmes extending by hitherto unknown innovations and numerous other exciting enterprizes, rather not easy to recount, are quite challenging propositions.

An engineer must continue to contribute with confidence his share when society and people in general turns to him for solutions. He must convince them that he is familiar with the current state-of-the-art and would be able to use the most recent knowledge to tackle the problem on hand. This necessarily requires that he must advance the frontiers of his knowledge by involving himself in self-renewal at repeated intervals. What he therefore needs is re-education from time to time which can lead out his potential through flexible, interacting programmes of study and on-the-job experience suited to his specific interests. This quest demands of him an interdisciplinary approach which alone can direct him into a vertical penetration and at the same time, a lateral exploration of engineering knowledge and enable him to closely interact with it in his professional environment.

In these contexts, what a "Professional Society" is now trying through its Continuing Education Programmes which are coordinated on national basis include, (a) to help one to combat the obsolescence malady, (b) to offer him a wide range of practical, creative, in-depth learning, problem-solving programmes, (c) bringing the engineer in him abreast of the significant advances in knowledge and breakthroughs in engineering and technology and develop him to learn to live with them. (d) to point out the fields needed to watch most closely in the complex millieu of taday as also in the days ahead, and finally (e) to equip him with the best possible technological tools to enable to get the most from the hours available to him.

2. THE PROFILE OF THE INSTITUTION OF ENGINEERS (INDIA)

India, the land of indo-gangetic plains and Godavari-Cauvery platequ, covering 3281,000 sq. km. of land area and inhabitated by about 640 millions people possesses, scientific and technical manpower rated to be the third largest in number in the world. Concerning the present discussion limited to only graduate level technical manpower. Fig. 1 will illustrate the growth of colleges and institutions at graduate level and technical manpower turn-over and stock over the past years.

In India from a meagre number of 11 engineering institutes giving graduate degrees with the first one established in 1847, there has been a considerable progress during the past few decades. The total number of institutions is now 144 with an intake capacity of about 30,000. The approximate stock of graduates which was about 229,000 around 1975 is now estimated to be around 280,000 (Fig. 1). This figure excluded the technical manpower that is produced through the efforts of Professional Societies by holding special examinations for working technicians. The Institution of Engineers owe its existence to Industrial Commission Report of 1916 and it

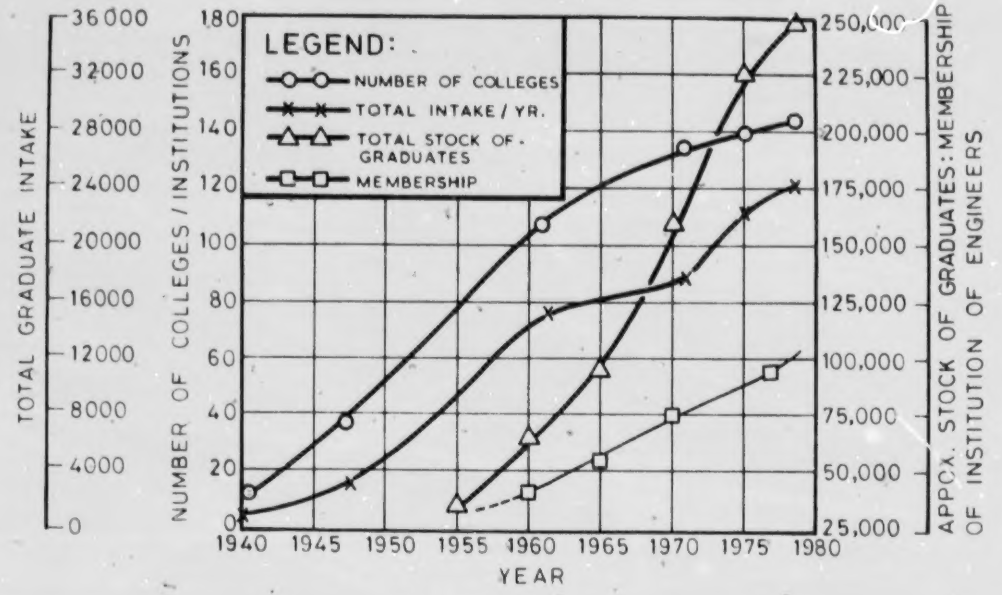

Fig.1 Growth of technical education and technical manpower in India

Table I*

Level of Responsibility (Higher downward)	Professional Task-mix			
	Manual skill	Technical skill	Management skill	Design and conceptual skill
Level- I (First Degree)	0.4	0.40	0.15	0.05
Level- II	0.25	0.45	0.20	0.10
Level- III	0	0.60	0.25	0.15
Level- IV	0	0.50	0.30	0.20
Level- V	0	0.40	0.38	0.22
Level- VI	0	0.30	0.40	0.30
Level- VII	0	0.20	0.45	0.35
Level- VIII	0	0.10	0.50	0.40

*(Figures in Table I indicate relative weightage of various skills: Adapted from a paper of D. L. Mordell presented in WFEO Seminar at Tripoli, Libya, September 6-10, 1978

was formally inauguarated in 23rd February, 1921. In 1935 the Royal Charter was given by the Privy Council giving it statutory recognition by which the Institution is still considered to be a legal entity in the Professional Scenario under the Negotiable Instruments Act enacted during the transfer of political power.

The objectives and performance of this Institution of Engineering are incorporated in the Charter which include-

a) to promote and advance science, practice and business of Engineering in all its branches in India.

b) .... to assure to each individual member, as far as may be possible equal opportunity to enjoy the rights and privileges of the Institution.

c) to diffuse among its members information on all matters affecting engineer and to encourage, assist and extend knowledge and information connected therewith by by establishment promotion of lectures discussions etc, by holding conferences by publication of papers, periodicals or journals, books, circulars, etc. by encouraging research, by the formation of libraries etc.

d) to promote study of Engineering with a view to disseminate the information obtained for facilitating the scientific and economic development of engineers in India.

e) to encourage, regulate and elevate the technical and general knowledge of persons engaged in or about to engage in engineering.

Thus, it may be seen that the basic objectives of the Institution of Engineers (India) can be grouped into three principle objectives:

1. to act as an agency for advancement of knowledge;
2. to promote professional competence;
3. to provide information storage and retrieval.

However, there are other responsibilities entrusted like the accredition of degrees of various engineering institutions, providing for alternate professional course programmes to working technicians etc. As the present topic is about role of the societies in the area of continuing education, the principal objectives outlined above will be taken up for further discussion.

Fig. 2 indicates the objectives, methods and exposition systems for fulfilling the objectives of the Institution of Engineers (India).

The Institution of Engineers (India) provides for both informal and formal type of courses as depicted in Fig. 2 by providing (a) continuing education courses (b) special knowledge programmes, (c) special research and development programmes organised through Indian National Design Forums.

The participants drawn from the industry, university and various other organizations are chosen in all these programmes or some of these programmes so that their immediate needs can be catered for. The above programmes sometimes are based on requiremnts of persons whose present state-of-the-art are at such level of appreciation of technology which might have developed a large gap with the current status of industrial technology. The another area in which these courses are usually offered where these can be designed for in-depth professional expertise and it is necessary that the modern breakthroughs as well as some solutions which are compatible with current status may be interposed in the form of "intermediate technology". The third area of thrust for informal or formal exposition is to develop the managerial component in engineering. The matrix shown in Table 1 will indicate that with the progress of a person in the professional career, managerial component increases. The demand of manual skill as well as technical skill decreases with rise in the level in profession. There has been a number of developments and progress in the area of management science and industrial engineering. Therefore, it is important that the subjects in the area of management science are provided in an integrated manner so that it fits into his technical domain as well as personal traits and requirements.

Exposition system basis shown in Fig. 2 indicates that the basic format by which an engineer required to function as well as can fulfill the task of updating himself is a mixed exposure involving (a) personal involvements and goals (b) professional needs and gaps (c) managerial training and education.

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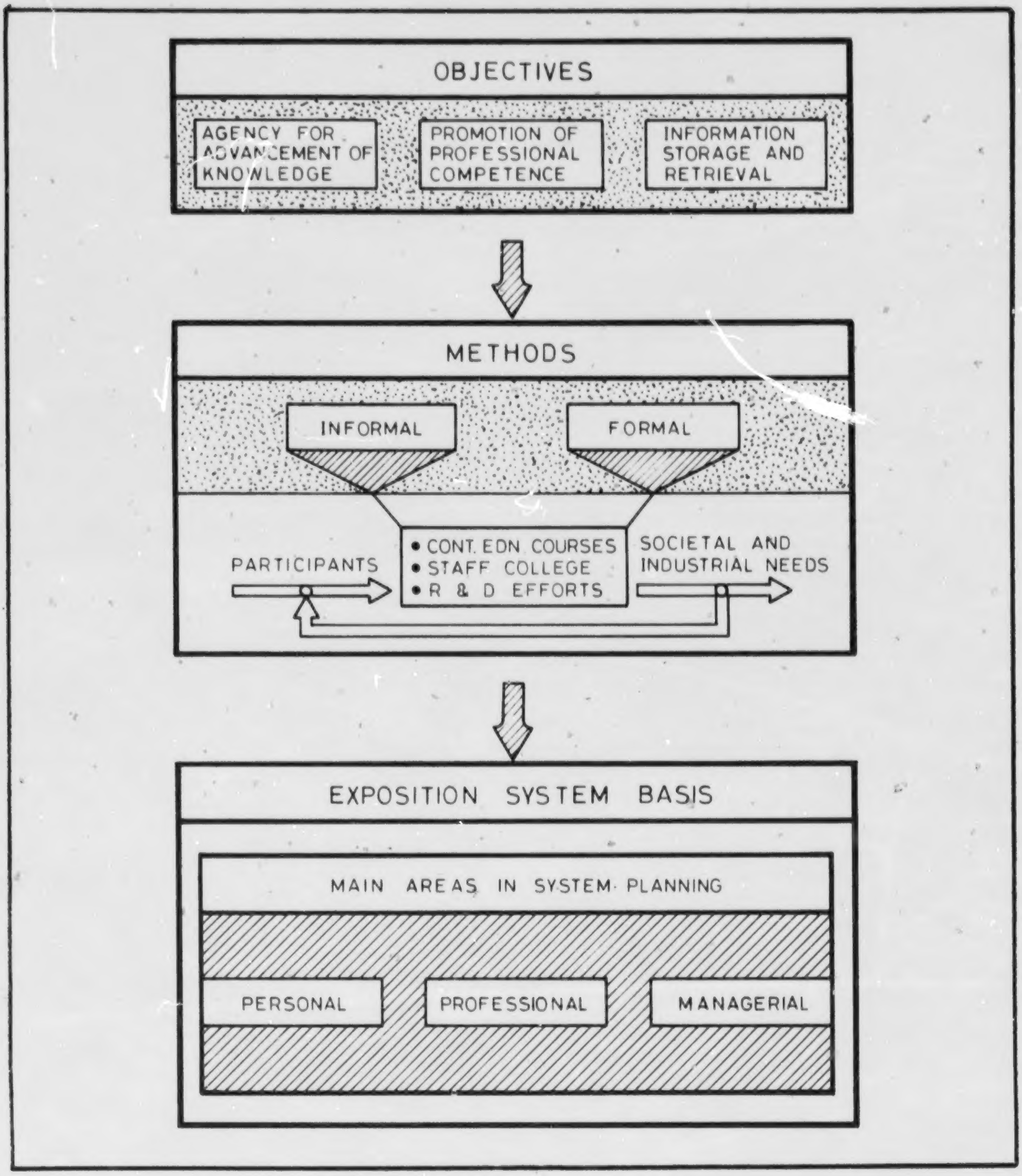

OBJECTIVES
AGENCY FOR ADVANCEMENT OF KNOWLEDGE
PROMOTION OF PROFESSIONAL COMPETENCE
INFORMATION STORAGE AND RETRIEVAL
METHODS
INFORMAL
FORMAL
PARTICIPANTS
• CONT. EDN. COURSES
• STAFF COLLEGE
• R & D EFFORTS
SOCIETAL AND INDUSTRIAL NEEDS
EXPOSITION SYSTEM BASIS
MAIN AREAS IN SYSTEM PLANNING
PERSONAL
PROFESSIONAL
MANAGERIAL

Figure 2: Basic Format by which Engineer is Required to Function

Table II

Determination of Relevance about the acceptability/criticality of a programme

Course	Factors				Relevance (R)
	X	Y	Z	ZZ	
	Weightages				
	w_1	w_2	w_3	w_4	
Course a	a_1	a_2	a_3	a_4	R_1
Course b	b_1	b_2	b_3	b_4	R_2
Course c	c_1	c_2	c_3	c_4	R_3
....					
Course i	i_1	i_2	i_3	i_4	R_i

3. NEED ANALYSIS

Fig. 3 shows the mechanism of "need analysis" carried out at the national level towards (a) development of subject domains and (b) programme structure for spatially distributed continuing education courses. Professional Society, in co-operation with the universities, develop a number of formal and informal programmes through which up-dating process can be persued. Feed-back informations from researchers of R & D establishments, industry-based engineers etc. are received through a network of centres and sub-centres.

A course relevancy is decided by several

factors:

(a) Number of responses or requests received for a particular programme (Indicative of technological awareness) (Factor X).

(b) Inputs from the university about the criticality of break-through domains (indicative of scientific progress and alertness) (Factor Y).

(c) Survey regarding the availability of such short course modules at the universities or other places (uniqueness of the subject matter) (Factor Z).

(d) Inputs from the industry about their needs and gaps (Alertness towards growing complexity of technology) (Factor Z Z).

A relevance table usually constructed to evaluate each course in the format of Table II.

The relevance is calculated as,

$$R_i = \sum_{j=1}^{j=4} i_j w_j$$

Usually, all factors are normalised so that,

$$\sum i = 1, \sum w = 1$$

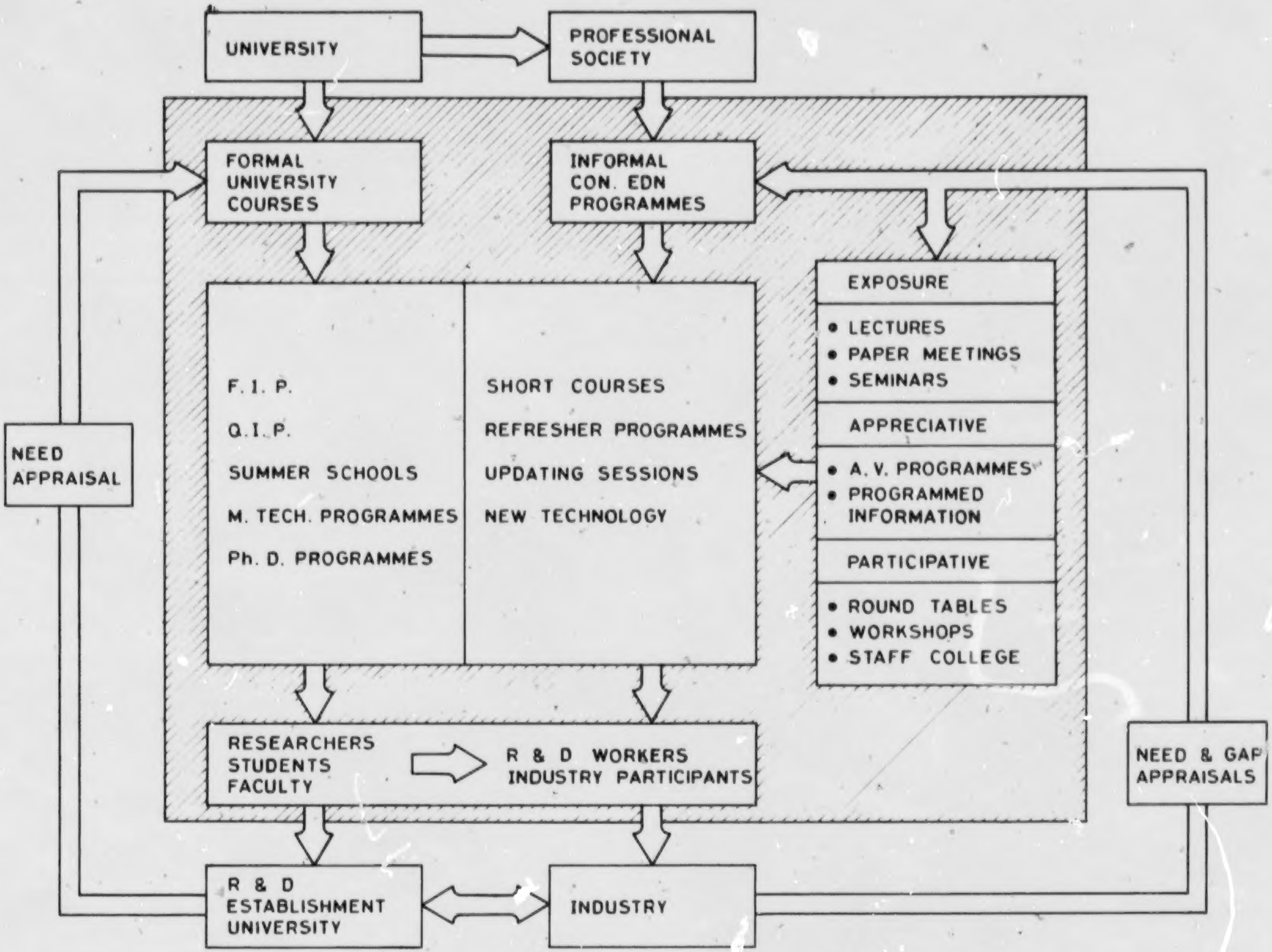
From the relevance table the heirarchy of the priority of the courses are evaluated and offered.

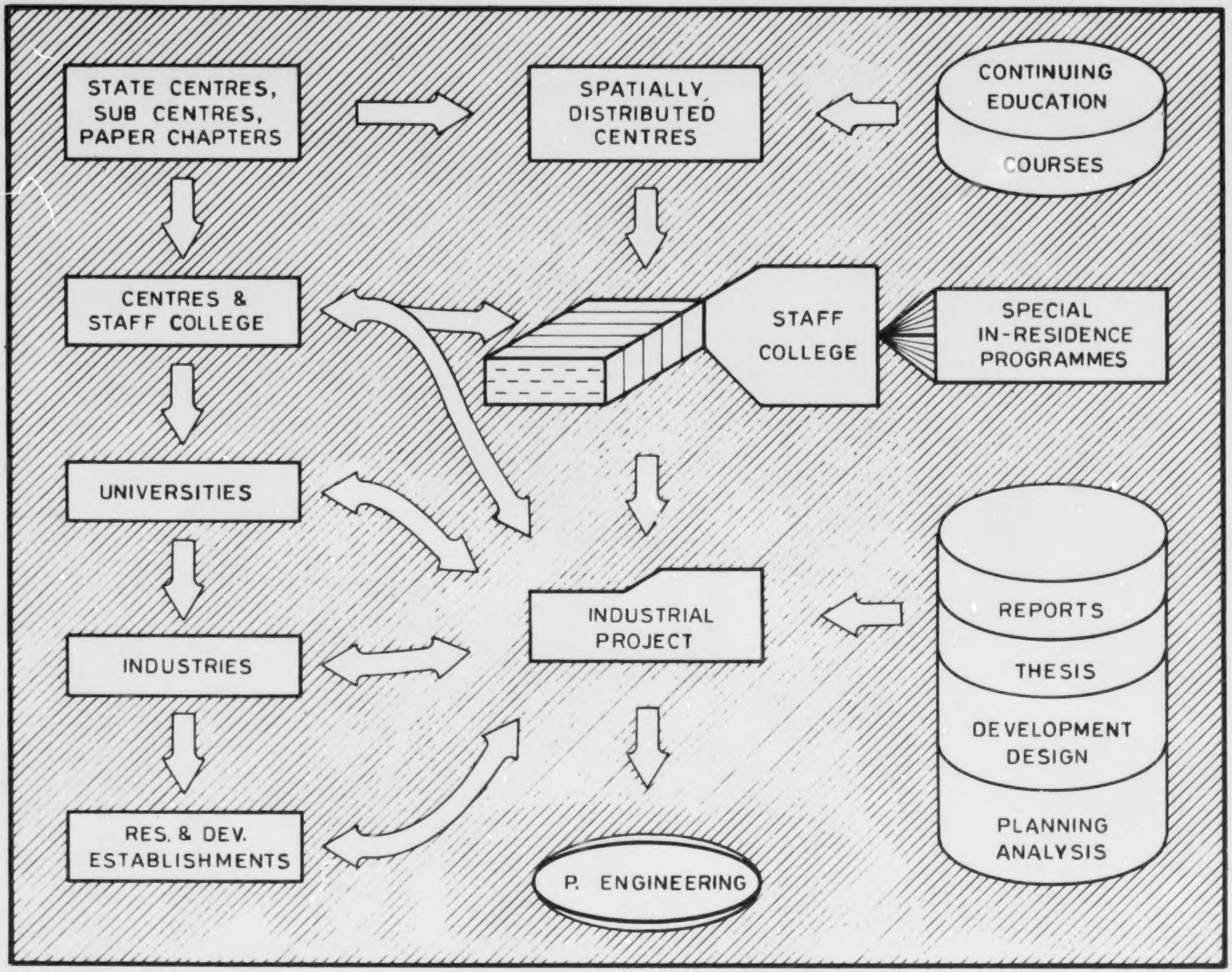
However, the continuing education courses are coupled with central staff college programme so that after completing these courses participants can interact with leading professional engineers and educationists for a longer period of time at the staff college.

The general programme of staff college conducted by the Institution of Engineers (India) are depicted below and indicate how relevant continuing courses are coupled with central programmes.

4. CONTINUING EDUCATION PROGRAMMES INTEGRATED WITH A CENTRAL ENGINEERING STAFF COLLEGE

The Institution of Engineers (India) subscribes to the idea that the professional learned societies must accept the responsibility of enhancing the viability of the profession by concerning themselves with all matters relating to continuing education. The offspring of this


UNIVERSITY
PROFESSIONAL SOCIETY
FORMAL UNIVERSITY COURSES
INFORMAL CON. EDN PROGRAMMES
NEED APPRAISAL
F. I. P.
Q. I. P.
SUMMER SCHOOLS
M. TECH. PROGRAMMES
Ph. D. PROGRAMMES
SHORT COURSES
REFRESHER PROGRAMMES
UPDATING SESSIONS
NEW TECHNOLOGY
EXPOSURE
• LECTURES
• PAPER MEETINGS
• SEMINARS
APPRECIATIVE
• A. V. PROGRAMMES
• PROGRAMMED INFORMATION
PARTICIPATIVE
• ROUND TABLES
• WORKSHOPS
• STAFF COLLEGE
RESEARCHERS
STUDENTS
FACULTY
R & D WORKERS
INDUSTRY PARTICIPANTS
NEED & GAP APPRAISALS
R & D ESTABLISHMENT UNIVERSITY
INDUSTRY


STATE CENTRES, SUB CENTRES, PAPER CHAPTERS
SPATIALLY DISTRIBUTED CENTRES
CONTINUING EDUCATION
COURSES
CENTRES & STAFF COLLEGE
STAFF COLLEGE
SPECIAL IN-RESIDENCE PROGRAMMES
UNIVERSITIES
INDUSTRIAL PROJECT
REPORTS
THESIS
DEVELOPMENT DESIGN
PLANNING ANALYSIS
INDUSTRIES
RES. & DEV. ESTABLISHMENTS
P. ENGINEERING

awareness is the Engineering Staff College, tobe reared under the aegis of the Institution of Engineers (India).

It is under the Engineering Staff College that the Continuing Education for engineers would be conducted within a well-knit, coherent and integrated programme.

The courses conducted will be of post-graduate flavour. The scheme of studies will follow two distinct patterns namely (i) Coupled--module and (ii) uncoupled-module.

The Continuing Education programmes are coupled as modules integrated with the Staff College programmes and, therefore, have standardized norms and guidelines.

The scheme provides for 3 distinct phases, namely,

Phase I - A set of evening or week-end part time courses conducted at specified State Centres, Local Centres and Sub-Centres of the Institution.

Phase II - A full time residential course at the Engineering Staff College.

Phase III - A project-report or a thesis to be submitted by each participant subsequent to the residential course after and within a stipulated time period.

Phase I

This will be run at specified State Centres, Local Centres and Sub-Centres as evening courses. It will extend over a number of relevant courses listed later.

At an average rate of two hours of instruction per day, it is expected to cover each of the above courses in about a total 20-50 hours in a month. The course will, besides teaching, involve the participants in a question-answer session, a group discussion and a test at the end of the course. Each participant will have to attain a minimum stipulated performance standard in each of the courses to be eligible to undertake Phase II.

Phase II

This phase will be run at the College in the form of a full time course with the participants residing in the College campus. These courses so handled by the College will be of a character very distinct in many respects from the courses being run by some of the staff colleges and universities in the country. The work assignment at the College will be of a specialised nature in advanced technology, which will be conducted in the form of courses, each course being tailored to the needs of particular groups from amongst one of the seven major disciplines of engineering.

Phase III

This will involve preparation of a thesis or a project report by the participant on a topic selected by him at the end of Phase I. It may relate to design analysis, research, experimental work or a management problem - depending upon the nature of his work in the profession - to which he would be initiated at the College. Every participant in this phase will have to complete the work on his thesis or project report within a period of 18 months of his leaving the College.

P. Eng. Diploma and Certificate

The College committee will expertly examine and assess each thesis or project report submitted by each participant who satisfies the above described conditions and when it receives final approval by the authority the participant will be deemed to have completed the entire course in all its phases. He will then be awarded the post-graduate professional engineering diploma of the College, which will entitle him to affix after his name the letters P.Eng.

The entire Staff College programme and the integration of it with the spatially districuted continuing education courses is indicated in Fig. 4.

5. CONCLUSIONS

The first phase of the programme has just been concluded for the first year covering about 287 courses at 69 different locations. A number of courses have been aided by renowned instructors/professors and professional engineers not only from India but also from abroad.

The second phase at the Staff College, with a mix of management courses and professional courses are acheduled from March, 1979 and by Dec. 1979, it is expected about 200 to 250 will receive P.Engg. (Professional Engineering).

This is not a new venture on the world scenario but certainly a deviation from decoupled random programmes designed in a manner to fulfill the needs and relevance of the profession as well as an attempt to bridge the ever-expanding knowledge gap.

A TRAVELING ROAD SHOW CONCEPT FOR CONTINUING EDUCATION

George G. Armitage
Manager, Canadian Region 7 (IEEE)
Institute of Electrical and Electronics Engineers
Thornhill, Ontario

The Institute of Electrical & Electronic Engineers is a transnational, professional, technical society, formed in 1963 through the amalgamation of the American Institute of Electrical Engineers and the Institute of Radio Engineers. It is a voluntary society, wholly supported by membership dues and self-generated publishing income. Membership in the Institute now exceeds 190,000 members who are located in most countries throughout the world.

The Constitution of the Institute states that its purposes are twofold:

Scientific and Educational - directed toward the advancement of the theory and practise of electrical engineering, electronics, radio and the allied branches of engineering and the related arts and sciences.

Professional - directed toward the advancement of the professions it serves.

The overall membership of the Institute is incorporated into nearly 300 Sections, based on geographical locations, each of which holds an average of 5 meetings per year at which technical papers are presented. A further division of the membership of the Institute is into specific fields of interest, as represented by some 31 technical socities, ranging from "the Acoustics, Speech and Signal Processing Society" to the "Industry Applications Society". Nearly 700 chapters of these Societies each hold at least two technical meetings during the year.

The Institute also sponsors over 100 major technical conferences annually where many papers on the state of the art are presented.

IEEE annually publishes more than 40,000 pages of technical information, representing over 10% of all such information published each year in their field of interest.

While this tremendous volume of technical information is, of course, available in libraries throughout the world, it is obvious that no practising engineer would have the necessary time available to read and digest some 150 pages of highly technical information daily.

Consequently, in spite of all these technical activities, it must be realized that, in order to keep up with the "information explosion", it is of vital importance that further steps be taken to ensure the continual up-grading of engineering know-how in order to keep engineers current with the state of the art through some specialized means.

IEEE, having recognized a need, has taken the necessary steps to assist the practising engineer through Continuing Engineering Education.

The Educational Activities Board of the Institute is directly responsible to the Board of Directors for policy recommendations on educational matters and for the broad planning of the corresponding activities of the Institute. In turn, the Educational Activities Board has set up a Continuing Education Department, which has been given the responsibility to prepare, offer and promote in co-operation with the Sections, not only short courses but also home study guides, slide and tape lectures and technical workshops in specialized fields of interest, for the members of the Institute and their associates within the profession.

Referring now to the Canadian Region of the Institute (Region 7), it should be noted that it is the only Region within the Institute constituting a single country. Membership within the Canadian Region exceeds 11,000, or 6% of the total membership of the Institute. These members are distributed across Canada, and are assigned to 18 Sections, located on a geographical basis and ranging in size from the smallest, consisting of only approximately 50 members, to the largest, which has a membership in excess of 2700. From our most easterly Section, which is located in St. John's, Newfoundland, to our most westerly Section, located in Victoria, British Columbia, the distance exceeds 6,000 kilometres.

In Canada, the centres of population are located in a narrow band extending approximately 300 kilometres north from our border with the United States. This situation, as you no doubt can judge, presents a very difficult logistics problem. In my capacity as Manager of the Canadian Region of the Institute, I endeavour to serve the needs of our Regional members and act as a connecting link on their behalf with Headquarters.

Canadian Sections, have, for many years, over and above their regular technical meetings, been originating and conducting Continuing Engineering Education courses within the boundaries of their Sections. They have, in practically every case, been using local talent and I have naturally been encouraging them to continue utilizing this method. As an example, in the 1977/78 Section season, I know of at least 20 short courses which were run by 10 of the 18 Sections. The courses basically have consisted of once a week evening sessions of from two to three hours, making up a 10-week course. There have been other courses consisting of full-day sessions held on 3 to 4 sequential Saturdays. Subjects presented have ranged from the specialized aspects of power generation and transmission to the application of semi-conductors and microprocessors and even on how to successfully organize and operate a small business.

In 1976, the Canadian Region conducted a five-day course on microprocessors in Toronto, which course had been prepared by the Continuing Education Department of EAB. This proved to be very successful, both technically and financially.

In 1977, following a report on this Microprocessor Course, discussions were held with my Regional Director, at which time it was decided to consider presenting in Canada, further courses that had been prepared by the Continuing Engineering Department of EAB. The criteria for the course selection was to ensure that it should have, as its prime purpose, the extension of the frontier of the engineers' education. It should be presented in such a manner that it creates a challenge. Further, it must establish a firm foundation on which the attendees can build an understanding of the application of new techniques. Having reached this decision and following investigation of the courses available from Headquarters, enquiries were instituted with the Chairmen of the various Sections in Canada to establish which subject or subjects would be of prime interest. As a result, we decided to investigate the possibility of presenting a course on the use of Fibre Optics for communications purposes, considering the advanced state of research and development work being done in this field in Canada and the urgent need for applications know-how. I propose, therefore, to go into detail on the various decisions that had to be reached to ensure the success of a two-day intensive short course entitled "Optical Communications Via Glass Fibre Wave Guides", which was conducted as a tour of eight cities across this vast country.

Significant savings in not only the instructional cost but in promotion and administration can be achieved in a multi-city tour, although frankly, I suggest it is potentially extremely hard on the lecturer. In the case of the Canadian Fibre Optics course, our lecturer, Dr. Robert Gallawa, came from Boulder, Colorado. For him to have come and returned from each of our lecture cities, would have cost over $3,000 in transportation. The actual cost of his transportation was less than $1,000. However, it did mean living expenses for an extra two or three days in each of the four weeks he spent in Canada. He did find that lecturing two days, followed by a day off, then repeating the two days of lecturing with a long weekend following, quite acceptable.

The first requirement was to establish some basic facts:

a) The availability of a suitable course on the selected subject

b) The availability of a suitable, highly qualified lecturer

Having established, with the Continuing Education Deparment of IEEE, the availability of a suitable two-day course, contact was immediately made with the lecturer, both my mail and phone to ensure his availability and agreement to a eight-city tour.

The next need was to decide:

a) the locations

b) actual dates of the course

In selecting the actual locations, we had to ensure that we utilized the most convenient locations for the maximum number of interested engineers to attend, while also allowing for rest and travel time between courses to best suit the convenience of the lecturer.

The eight-city tour was to be broken into two segments - a western 3-city tour and an eastern 5-city tour, with a short break in between the two segments for the lecturer to conduct personal business. Further, having reached agreement between the lecturer and this office, we still had to ensure the co-operation of the Section Chairmen and their local Section Executive in each of the eight selected cities.

Having established the answers to the questions of

WHY?

WHAT?

WHO?

WHEN?

and WHERE?

and having already satisfied ourselves that the course would be a technical success, there remained further problems related to the financial success.

The Institute of Electrical & Electronics Engineers is a non-profit corporation. While we are a non-profit organization, there is no stigma attached to creating a reasonable surplus from the operation of a convention or short course. A basic rule of thumb that has long been utilized by the Institute in budgeting for both conventions and short courses in order to ensure at least a financial break-even is:

> all budgets should be based on an expected surplus of 15% of cash flow, being conservative when estimating projected income and by estimating expenses on the high side.

Further, it should be realized that while we are trying to help our members, at the same time we are endeavouring to induce non-member engineers to join the Institute. Therefore, there should be a differential between member and non-member fees of such magnitude as to encourage membership applications which, should they be submitted prior to the actual start of the course, would permit registration at the member price. Also those registering as students must be student members of the Institute to qualify for their special rate. Further reduced rates should be used for early pre-payment of registration fees.

Now getting down to details in order to establish the expense budget for the course, many items had to be considered.

By broad categories, it is necessary to establish best estimates under the following main headings:

Instructional Cost

Promotional Cost

Course Materials

Social Events

Administration Costs

Indirect Costs

It is my intention to consider each of the items of cost in detail.

However, before proceeding, I should point out that a very considerable savings was made by the fact that contact was made with the national sales office of the Commonwealth Holiday Inns of Canada Ltd. and arrangements were made to use the facilities of the Holiday Inns from coast to coast. Due to this fact, special rates for accommodation for both the students and the instructor were extended. Rental of the lecture halls was also reduced as a result of having a luncheon each day for our students.

INSTRUCTIONAL COSTS

Instructor Honorarium

The honorarium to the instructor was based on $300 per lecture day and no doubt would be somewhat higher now due to inflation.

This meant an estimate of $4800 covering two days in each of 8 cities. Actually, this item turned out to be $5509 Canadian funds, due to the variation in the exchange rate between the Canadian and the American dollar as the honorarium was payable in U.S. funds.

Instructor Travel

This was estimated at $1,000. It should be noted, however, that some of the travel was by car and this represented a savings of over $200 as no charge was made in this respect to the instructor travel item but rather was included in the Incidental Items of administration.

Instructor Meals and Lodging

These were estimated at $1600 based on 27 nights at $60.00 per day.

Special Audio Visual Preparation

Nil

Registration and Security at Course

No estimate was inserted for this as the courses were being run under the supervision of the local Section who were responsible for the issuance of the course notes and other materials. In turn, each Section was to share in the surplus created by the course at their location.

PROMOTIONAL COSTS

The promotional cost of any short course requires consideration of how the largest number of potential students can be reached at the least expense. Basic coverage in our case required both national and local promotion.

National Promotion -

was taken care of by advertising in two of our leading technical magazines at a total cost of $2,000. As well, the course was advertised in the Canadian Regional Newsletter which was sent to all members of the Institute in Canada. This Regional Newsletter advertising was actually gratuitous.

Local Promotion -

was actually the responsibility of the local Section Chairman and his Committee. To assist them in this regard, reprint copies of the magazine advertisements were supplied to the Section who took care of special local distribution. Further announcements in some locations were published in the monthly Newsletter of the Provincial Association of Professional Engineers and other local technical bodies. Direct contact was made with key personnel at the local telecommunications companies, electric power corporations, the cable and TV operators, as well as the universities and other potential users of this important means of communication.

Direct Mail

As I have indicated above, the direct mail portion of the estimated cost was actually taken care of as part of the Regional Newsletter and no expense in this regard was included in our estimates.

Design of Flyer and Ad

Here, with the assistance of the national magazines, an ad was designed with costs included in the costs of the space and as indicated, the flyer was merely a reprint copy of the advertisement, which was obtained at minimum cost of $16.00 per thousand.

Labels and Mailing List

This item should be considered but in our case, was covered by the labels for our Newsletter and the national distribution of the two magazines.

COURSE MATERIALS

Course Notes

Arriving at suitable estimates for the cost of the course notes proved to be somewhat difficult as the number of copies to be printed depended on the number of registrations for the course. However, with the co-operation of IEEE Headquarters in the United States, who anticipated supplying course notes for the identical course to be run within their country, it was agreed that we could overprint within reasonable bounds and supply surplus copies to them for use in future courses. This agreement enabled a significant reduction in cost per copy. Actual cost proved to be $5.83 per set of 200 pages, collated, with each set of notes pre-punched for insertion into a 3-ring binder and individually wrapped in clear plastic. This was done to enable shipment of the notes and binders separately and this was to ensure that no damage was done to the 3-ring binders by shipping notes already inserted. It proved to be an extremely satisfactory method, requiring less than one minute per set of course notes for insertion into the 3-ring binders at the course location.

3-Ring Binders

A standard 3-ring binder, prepared and stocked by the Regional office, has been used by many of the Sections in Canada as a cover for course notes at their various courses. One feature of this binder is a clear plastic pocket on the spline where a title may be inserted making the binder universal for all courses and other usage. Cost of these binders to the course was $3.00 each.

Text Books

In the case of the Fibre Optics Course, the course notes were the only text supplied and consisted of approximately 90 pages of text and 110 pages of copies of the transparancies used by the lecturer.

Slides and/or Transparencies

The original costs of the transparencies were absorbed in overhead.

Samples for Demonstration

No costs were incurred insofar as samples were concerned.

Lecture Hall Rentals

These were estimated at a cost of $75.00 per day as we were able to obtain this low rate in view of the fact that luncheons were served daily to the students as part of their registration. Further, a reasonably large number of rooms were occupied by the students during the course.

Audio Visual Equipment

The original estimate was $50 per location, although it was found that in some cases the actual cost was included in the room rental. In every case, a public address amplifier was built into the rooms utilized so this did not form a cost.

Transportation of Notes and Equipment to Site and Return

Cost in this case was estimated to be a total of $300, the actual being somewhat less than $200 as in some cases, the material was transported by private car.

SOCIAL EVENTS

These costs, of course, depend entirely on the number of students registered and original estimates were based on attendance of 50 students at each location.

Coffee Breaks

50¢ per person per break

Luncheons

Lunch was to be supplied as part of the registration fee on both days of the course with the best estimate being $7.50 per student per day which included taxes and gratuities.

Special Entertaining

No expenses were budgeted.

ADMINISTRATION COSTS

Administration costs are an item where it is important to come up with a good guess as it is not possible to keep detailed track of all actual costs. In the case of the Fibre Optics course, the best estimate that we could come up with was $2,000 for incidentals and $3,000 for general overhead. This turned out to be reasonably accurate. Among the items to which consideration must be given are the following:

Correspondence
Telephone
Co-ordination of Advance Registration
Administration at Course
Identification tags for students
Special receipts for tax purposes
Preparation and mailing of Completion Certificates
Accounting and Reporting
General Overhead
Incidentals.

(In Canada, the Department of National Revenue permits the deduction of the cost of IEEE Continuing Education Courses from income for income tax purposes, on presentation of a specially worded receipt signed by an authorized official. These receipts are supplied to all students who have subscribed to the course on their own behalf. It is not legal to supply them when the registration fees have been paid by the employer. These receipts, together with the suitable inscribed certificate are mailed out to the student shortly after the course has been presented.)

INDIRECT COSTS

Course Development

Some significant costs are usually incurred in developing any short course before presentation. In the case of the Institute, this is normally capitalized and pro-rated over the number of times the course will be presented.

Course Reviewer

After preparation of a course, it is submitted to a group of peers for evaluation and revue and here again, the costs are normally capitalized and pro-rated.

Our final expense budget based on 50 students at each of eight locations worked out as follows:

EXPENSE BUDGET SUMMARY

Instruction	$8,000
Promotion	4,500
Course Materials	5,000
Social	7,500
Administration	5,000
Indirect	3,000
	$33,000
Plus 20%	6,600
Contingency	$39,600

INCOME

Having finally arrived at a projected expense budget, the next move was to establish registration fees.

In view of their past experiences with courses of similar duration, discussions were held with the Continuing Education Department of the Institute. Their recommendation was that we should utilize the following fees which had been previously established and found to be acceptable to the students.

Two-Day Course Registration Fees

	Member	Non-Member	Student
Up to 14 days before	$130	$165	$60
At time of course	150	188	70

Using these rates and basing all income on early registration with an average attendance in each city of 50 students, income was predicted as follows:

30 Members at $130	$ 3,900
10 Non-Members at $165	1,600
10 Students at $60	600
Income per Location	6,100
Total Income	$48,800

After examining the effect of deducting the basic requirement of a 15% surplus from income ($7,500), the decision was taken to maintain the established fees as set up by Headquarters for registration. While this would tend to create a larger surplus than the 15% if everything operated according to plan, the final figure for surplus was accepted as within reason.

RESULTS

The first presentation of the two-day short course entitled "Optical Communications Via Glass Fibre Wave Guides" was presented in Vancouver, British Columbia on March 30th and 31st, 1978, followed by presentations in Edmonton, Alberta; and in Winnipeg, Manitoba the following week. After a short break, presentation was continued in Halifax, Nova Scotia; Montreal, Quebec; Ottawa, Ontario; Toronto, Ontario; with the final presentation in London, Ontario on Friday and Saturday, April 28 and 29.

The presentation in Vancouver was the first time the course had ever been presented. As it was re-presented across the continent, modifications were made to the course content such that it was radically improved when presented in London, Ontario.

In stating that the course was much improved at its final presentation, it should be pointed out that the changes consisted mainly of a shift of emphasis in order to stress those points brought out by questions from the students, rather than course content.

ANALYSIS OF ATTENDANCE

The mix between members, non-members and student members was, when analyzed, discovered to be radically different from that predicted. A total of 290 students attended the course consisting of:

97 Members
173 Non-Members
12 Student Members
8 Complimentary Courses (1 complimentary course was given at each lecture for the local co-ordinator)

Attendance at the course ran from a low of only 17 in Vancouver to a high of 57 in Winnipeg. The different results were entirely due to the varying enthusiasm shown by the local Section towards the course and, as a consequence, the efforts contributed towards the local promotion.

FINANCIAL RESULTS

Income	$42,000
Expenses	$25,000
Net Surplus	$17,000

Distribution

In our initial discussions with the Section Chairmen, an agreement had been reached as to the sharing of any surplus created. The computing of income from registration fees at individual locations presented no problem. Insofar as actual expenses were concerned, the agreement was that the bulk expenses, such as the honorarium to the lecturer and his travel expenses, national advertising and general overhead, would be shared equally by all locations. Other expenses, such as actual cost of luncheons, quantity of course notes, etc., could be assigned to each location. Based on this breakdown, each Section where the course had been held, was to receive 1/3 of any surplus created by the course at that location. The balance of the surplus was to be split equally between the Continuing Education Department of the Institute and the Canadian Region.

SUMMARY

At the conclusion of the course in each city, a questionnaire was distributed to all students, asking them to comment anonymously on various aspects of the course. When analyzing the replies, it appeared that 75% of the students were enthusiastically satisfied with the presentation and a further 10% felt that attendance had been worthwhile. 15% were dissatisfied with the course. The prime cause of dissatisfaction proved to be that in spite of the stated requirement in the announcements of the course that an engineering degree was a prerequisite, the student did not have the required educational background but was rather at the technician or technologist level.

As a result of the interest created by this transcontinental tour, the course was presented in Regina, Saskatchewan, in late September of 1978 where it was received enthusiastically by 33 students. It is anticipated that the course will be presented in Quebec City, Quebec in early 1979.

One further interesting result of the tour is that three other Sections who had never, up to that time, sponsored Continuing Educational Courses, have done so this past season with outstanding success.

CONCLUSIONS

Short courses, sponsored by IEEE, are primarily oriented towards industry applications, having been designed to improve the technical excellence of our members and increase their knowledge and skills in new areas. The Travelling Road Show concept of Continuing Engineering Education not only met these objectives but, in addition, has created greatly increased enthusiasm among the leaders of our Sections to continue to expand their efforts in the field of Continuing Engineering Education for the benefit of the Electrical and Electronics Engineering Profession.

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AN INTERNATIONAL PROFESSIONAL SOCIETY'S APPROACH ON CONTINUING EDUCATION FOR ITS MEMBERS

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ABSTRACT

A goal of IEEE is to provide continuing education to its membership. How to open such pathways to opportunities in this transnational organization with world-wide membership is the concern of the author. One means established is the "Traveling Instructor" program and is detailed in this paper. The author also looks at variations of the program that may increase its effectiveness.

IEEE ORGANIZATIONAL STRUCTURE

IEEE membership is a world-wide affiliation of nearly 190,000 professional and technically competent individuals. Each is assigned to a local Section based on mailing address. There are over 230 of these Sections and they are established within ten Regions that serve as centers of activity at the local level. For quick reference the U.S.A. is divided into six Regions; Canada is designated Region 7; Europe, Region 8; Mexico, Central and South America, Region 9; and the rest of the world Region 10.

Proof of the transnational nature of IEEE is furnished by the more than 20,000 members residing in Regions 8, 9, and 10. This is a fast increasing strength as new members continue to join IEEE.

Local activity in Section affairs is encouraged and is a means by which members can share in educational and social opportunities. Another pathway to participation by the IEEE member is offered through 34 separate Technical interest organizations designated as Societies or Groups.

The strength of numerical support, enhanced by opportunity for local participation is amplified further by membership in IEEE Technical Societies. These offer the advantage of shared experiences in a specialized field. Each Society publishes one or more technical periodicals called Transactions that record and disseminate new information in its field of interest. Most also publish a periodic newsletter. Individuals may join as many Societies as desired upon payment of a modest annual fee.

Certainly one of the major strengths of IEEE in transnational education is found in the IEEE Societies; their periodicals, conferences and workshops.

CONTINUING EDUCATION

IEEE is committed to the continued technical education of its members. As just noted, one ongoing means to this commitment is through the activities of the Technical Societies. Most likely, for many members, such participation fulfills immediate and recognized needs. The career development or insight into new fields often requires, however, a greater stimulus or in-depth probing. In many countries within Regions outside the U.S.A. national societies provide educational opportunities including continuing education courses. Such courses may entirely meet the personal needs of their memberships. Since IEEE members are more than likely also members of a national society, the combination of IEEE information and local educational opportunities may well close the technical-knowledge gap for most.

As also observed in the U.S.A. a need truly exists for a Continuing Education program to meet individual needs. The IEEE Educational Activities Board (EAB) sponsors such a program that is broad in variety of material and delivery modes. Content of IEEE short courses is usually designed to be at the cutting edge of technology. In other instances the courses provide the means to sharpen old skills and add those needed for career enhancement.

Every part of the program is available to all members of IEEE in all Regions. Practically and realistically the system works easiest and most often in the U.S.A. and Canada (Region 7).

Perhaps a better understanding is required of how IEEE has used its size and technical strengths to develop a strong and top-quality continuing education program.

The 34 Societies are divided into seven Divisions. The Societies and Divisions are represented by the IEEE Technical Activities Board (TAB).

The technical strength of IEEE is brought to bear on the development, instruction, and quality control of course content. Many of our course instructor/authors are active in TAB organizations and are recognized leaders in their fields of expertise. Every course must also receive a review and approval of the appropriate TAB organization before EAB will schedule any presentation.

We attempt to maintain a continual evaluation of course content, teaching quality and student reaction. One means by which we obtain information is through the use of a course-evaluation form "How Did We Rate With You" completed by every student at the completion of course. The other greatly important means of continual evaluation is through the TAB review system. Initial approval is for two years; or less if the material is in a dynamic state of change. Our state-of-the-art courses are thereby kept at a peak of excellence.

Survey of the membership is used to determine interest in specific areas and modes of delivery. One such survey just completed indicated that home-study courses rank high on the member's choice for continuing education. Our market studies have been able to match subject and methods to help produce the increasing participation by members.

From such a program of dynamic content, IEEE courses are highly recommended as meeting needs, having quality-assured material, and remaining at top-form through constant evaluation.

TRANSNATIONAL PROGRAMS

The foregoing review of the very nature of IEEE; its relations with a world-wide membership; and its continuing education program sets the stage for a look at how the latter is faring.

As noted previously, the more than 20,000 members of IEEE in Regions 8, 9 and 10 find continuing incentive for participation through IEEE publications, technical activities and educational programs of Regions, local Sections and national technical societies. Some IEEE members also take advantage of the Home-Study programs offered by the EAB.

There has been a growing expressed interest for local sponsorship of EAB short courses. The EAB has responded to requests for specific short courses in several ways--each fraught with more problems than solutions. In some instances, the entire "package" was exported to the local area leaving details of promotion and course attendance up to the members. Too often, the overall costs outweighed the income. A few courses were presented anyhow and were smashing successes in all respects except at the "box office." Others were cancelled outright. Courses have been taken on tour, but did not return their expenses.

Recent examples of success to all concerned can be found in the five-day Microprocessor Hands-On Workshop sponsored in December 1977 by the India Council of Region 10 and the 1978 tour of five cities in Region 7 of the new Fiber Optics course. This latter program is the subject of a separate presentation at this conference.

Occasionally a series of lectures has been presented in Regions 8, 9 and 10 by Society members combining a business trip with presentations of tutorials. These lectures are valuable and partially fill the need for the transfer of new technology.

The concern by EAB that members anywhere be able to participate in the IEEE short courses was not met adequately by any of the foregoing means.

THE TRAVELING INSTRUCTOR

From this transnational concern of EAB has developed the concept of the Traveling Instructor. Geared to bringing affordable courses to members of non-U.S. IEEE Sections, the program seeks out U.S. members who are traveling outside the country on business or for pleasure, and attempts to match the expertise of such travelers with the needs of IEEE Section members in the vicinity of the travelers' destinations.

The member who qualifies as Traveling Instructor, must be one of the experts in a particular field, and have proposed course material approved through the EAB/TAB quality-control system. Through the IEEE Societies, these members may be well known world-wide. In any event, the course content may well offer the local IEEE Section and the national society an opportunity for a topical update otherwise difficult to arrange.

Beside the obvious advantage of having the instructor on the scene who can deliver a program of local technical interest is the cost advantage of the system. The only travel expense involved is for local, lateral transportation and local living expenses.

The plan works like this. IEEE, determines the travel plans, with dates, of the potential instructors and possible subject matter. This information is cabled to all leaders in Regions 8, 9 and 10. The timing is usually at least five months before any travel and this permits local response and notification of the instructor. The local Section makes all arrangements for the one- or two-day course and the instructor prepares and submits his course material to EAB for approval.

The timeliness of the subject matter, its quality and the presentation by an expert in the field make each of the courses a blue-ribbon event and justify attendance fees to cover expenses.

For example, the table shows a possible budget for a two-day course. The overall cost can be met by 20 attendees paying $80 each; or by 40 attendees paying $40 each. In many countries this expense is covered by the employer. Another possible means of meeting expense is through Region and/or national society cooperation. In most all cases, there can be a mutually agreeable plan if all parties concerned make certain communications are clear and the desire for the course is of top-level importance locally.

TRAVELING INSTRUCTOR - BUDGET
Two-Day Course

Local Section Expenses*	$ 800.00
IEEE Headquarters Expense**	700.00
Total	$1500.00

*Instructor per diem expenses, Textbook reproduction, Completion Certificates, Local Facilities, Evaluation Fee, Service Fee, Promotion.

**Honorarium, Local Travel to Course Site.

The following Table lists courses that were potentially available this past year and the areas that were within the reach of the Traveling Instructor.

1. Courses Available

- Differential Equations, Z Transforms, etc.
- Computer Communications
- Optical Communications
- Project Management
- Financial Management
- Solar Electric Systems
- Digital Signal Processing
- Charge-Coupled Devices
- Optimal Control
- Technical-Writing Seminar
- Microcomputers
- Various Computer Courses
- Fundamentals and Applications of Protective Relays
- Protection and Grounding of Distribution Systems
- Digital Communications
- Signal Processing
- Digital Filters
- Advances in I.F. Detection Techniques
- Phase Locked Loop Design

2. Areas (some specific) Within Planned Visit of Instructors

Belgium
Denmark
Finland
France
Hong Kong
Korea
Tokyo
India (Bangalore)
Munich
Poland
Sweden
Great Britain
Hungary
Germany
Spain
Switzerland
Greece
Italy (Turin)
Italy (Rome)
Philippines
Taiwan
India (Bombay)
India (New Delhi)
Hawaii
Mexico
Guatemala
Costa Rica
El Salvador
Australia
Singapore
Peru
Argentina
Brazil
Israel (Haifa)

The "Traveling Instructor" plan is one approach to transnational continuing education. The system offers high-quality course presentations in distant countries at a very low cost per attendee.

LOOKING AHEAD

The EAB Continuing Education Activity has recognized the need for further reducing the cost of quality education to those areas especially where travel costs can be prohibitive. One plan under consideration is the development of specific course material that can be used by local instructors. The cost for this type of course would be extremely low.

Where possible, IEEE will in the future make available the rental of video-taped courses. It is believed that here is the opportunity for a Region to set up and sponsor a "tour" of the tapes.

In recent conversations with leaders of Region 8, a variation in the system has developed. The suggestion is intriguing--invite a recipient of a major IEEE award to deliver a short course. Such an event was felt to be of interest to both IEEE and national societies and would have substantial sponsorship.

Another variant suggested is to develop an instructor/course program in a Region and apply the "Traveling Instructor" system to this "local" version of the idea. It would not be unlikely that an instructor from Region 9, for example, might be invited to present a course in one of the U.S.A. Regions.

SUMMARY

The "Traveling Instructor" whether he be live, on tape, or by proxy through the use of his course material seems to be one way to meet transnational needs of IEEE members. The goal for IEEE is to provide continuing education to its members--and particularly to provide the pathways toward the goal.

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Prior to joining the IEEE staff, he was Manager of Commercial Engineering for RCA Corporation responsible for technical information and publications.

A BSEE from the University of Toledo, Mr. Wilhelm has been active in continuing education, technical publications, promotion and marketing of industrial tubes, solid state devices and picture tubes. His industrial experience also includes design and development of industrial tubes and black-and-white and color picture tubes. He is a member of Tau Beta Pi and a Senior of the IEEE.

His many hobbies include photography and amateur radio station K2OZW which he operates from his home in Maplewood, New Jersey.

SOCIAL, POLITICAL OBSTACLES TO THE LATIN AMERICAN TECHNOLOGICAL DEVELOPMENT: IT'S IMPACT IN UP-TO-DATE PROFESSIONAL KNOWLEDGE

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Dr. Marcos Kaplan

I.- The diagnosis of the problems of the engineer's continuing education, strategy, and specific solutions for them, brings up another matter: the sociopolitical dimension of science and technology (1).-

Science and technology are social activities and institutions, related to other societal activities and institutions and conditioned by them,- but not in a linear and mechanical way. Science and technology have a relative autonomy, their own dynamics and efficacy, capacity to retroact on themselves and on other levels and aspects of society. They make an impact on the economy, social structure, culture, and idelogies,-and national and international politics.

Science and technology being social, have political dimension. They are increasingly a source of power -potential or effective- for classes, groups, institutions, and nations. They are or have the ability to be a factor of productivity, well-being, domination, exploitation, aggression, and destruction. Every decision and activity related to them, as well as their end products and their uses, have political character. Science and technology are conditioned by the structures of power and by the general political ambience. They are integral elements of political action, and the object of political decisions. They constitute motives, ends, and desired outcomes of political action. Politics can thus be an obstacle or stimulus for scientific and technological development.-

The training of engineers, the possibilities and consequences of their activity, depends on what the national society and its developmental model are and can be. It also depends on what the political system and the State is and does. The problem of the continuing education of engineers requires the interdependence of several perspectives: between past, present, and future; between diagnosis and its alternative; between physical-natural sciences and human and social sciences; between social practice, scientific theory, and the utopic component; between knowledge, criticism, and the project of transformation (2).

This perspective rejects the limitation of any science by rigid paradigms or the subjugation by feudal exclusivism of experts within water-tight compartments. It aims at promoting the development of a transdisciplinary theory and thought, that has both as a point of reference and object open, multidimensional, and complex systems. That can contribute at the same time to the diagnosis of underdevelopment and dependency of science and technology in the Latin American countries, to the strategy to overcome that situation, and to the better management of the problem of continuing education.

II.- The Latin American countries have received a negative historical legacy. The colonial tradition implies sterility and poverty in research and innovation. The societal and developmental model in the XIX century and up to 1930 determines the lack of demands, stimuli, motivations, and possibilities in the fields of science and technology; the hostility to its internal advancement, or the unconsciousness of the necessity of scientific development from within and oriented towards the nation. Science and technique are incorporated as finished products, in the form of consumer goods and producer goods, published works; or as research undertaken in Latin America, by European and United States scientists working on problems and with objects and local materials, but for ends foreign to the countries of the region.-(3).

During the epoch of the structural crisis, from 1930 to the present, the scientific and technical development is affected in general by the aspects and the end products of a transformation that intwines internal and external factors. The countries are inserted into an international system characterized by highly concentrated and centralized structures of power, by the hegemony of the United States in the region, by the preponderant influence of the multinational (4). The external dimension is intwined with a new phase of economic growth and social change: crisis and modernization of the primary production and the rural society; extreme urbanization; substitutive-dependent industrialization; modifications in class structure; state intervention; emergence of an underdeveloped and dependent late neocapitalism (5).

III.-The neocapitalism links large national and international enterprises. It specializes production for export, and for an affluent internal market of high middle urban groups. It makes use of a submissive and cheap labor and of the protection of the state. It regressively redistributes income. It disassociates economic growth and integral development. It depresses the levels of renumeration, consumption, and the well-being of the masses. It presupposes or promotes a social and political order lacking in participation, apathetic and subjugating the will of the majorities. Modern and dynamic types of economic sectors, associated with the multinationals, predominate but prevent the coexistence of enterprises of lower productivity and yield that have underdeveloped and archaic economic nuclei.

Neocapitalism mobilizes masses of middle and popular classes; it multiplies and intensifies their necessities and demands. On the other hand, it establishes privileges for certain enterprises, segments, classes, and regions, to the impairment of the others who are the majority; it implies a marginated dynamic; it generates and multiplies tensions, conflicts, and antagonisms; it requires a concentration of power and an extreme authoritarianism for the objective of accumulation and yield of the great enterprise.

This contradiction generates and accentuates the tendency to the entrophy of the system. It is manifested in situations of social conflict, political instability, break down of legitimacy, breach of consensus, coersive resources weakened or made insufficient, power vacuums, crisis of hegemony, and recourse to authoritarian and to talitarian solutions (6).-

Within this historical frame, that already shows some sociopolitical clues for the explanation of the scientific and technological underdevelopment, the most specific factors and mechanisms that are placed are the following.

IV.- The concentration of world power and the hegemony of the government and the multinational corporations of the United States and other advanced countries, contribute to establish an asymmetrical system of the international division of labor in research and innovation, and the breach in science and technology(7). That implies:

1) Lack of free and immediate access for Latin American researchers and technicians to the accomplishments of world science.

2) Lack of substantial international aid in the form of independent resources so that the Latin American countries can foment an investigation potential centered on their problems.

3) Promotion of the scientific and technical dependency, through the import and mimetic adoption of intelectual instruments, knowledge and processes, in the form of finished products.

4) Placement within the developed countries of centers of production and diffusion of science and technique, with ethnocentric implications: conception and elaboration based on local and systematic contexts and motivations and for particular ends (wealth and power of the States and corporations of origin; domination and exploitation of the underdeveloped world); lack of preoccupation for investigation and innovation concerned with the specific problems of the Latin American countries.

5) Promotion of the transfer of science and technology within the developed countries, through equipment given to the subsidiaries of multinational corporations, and of the licenses and agreements for technical assistance between the multinational corporations and national enterprises.

The indiscriminant transfer of technology implies the use of equipment and productive methodology designed for different structures and levels of development, unsuited to the conditions of the receiving countries, generators of stumbling blocks and disequilibrium. Technology is introduced that is known, amortized, and obsolete in the metropolis, either surpassed or discarded; capital intensive; reducing the levels of occupation and the standards of living of the majority; favorable to the concentration of income and monoply, to the distortion of demand and of productive structure.

6) Reinforcement of the ability of penetration of the multinational corporations, of the displacement of national enterprises, of the general dependence of the Latin American countries toward the metropolis.

7) Lack of effective contribution on the part of multinationals to autonomons investigation and innovation in the countries of implementation.

8) Decisive role in the "Brain Drain" (internal and external)

V.- Internal factors and mechanisms of delay and dependence on science and technology are alone all of the following:

1.- Role of tenancy and use of the land, expecially the predominance of the latifundio which implies: lack of incentive and social pressure in favor of investigation and innovation; insufficiency and inadequacy of agricultural mechanization; low yield; limitations of expansion and development with regard to quantitative orientation, distribution by agrarian sectors (8).

2.- Latin American industrialization is given as a substitute for importations, a dependent and peripheral process, without industrial revolution. It is a result of international and national processes which no one has desired or forseen. It has lacked a deliberate strategy, coherent politics and systematic programming. It has respected the limitative structures and forces of development, especially the latifundio and the predominance of multinational corporations. It has utilized and promoted a modification of dependency (displaced financial and technological), the availability of cheap and abundant manual labor, the combination of low salaries and costs with high prices in a protected market. Multinationals have united their capacity for importing sophisticated technology in their own metropolitan centers, and the implications and consequences of this monoply, with the enjoyment of favorable conditions mentioned above. National businesses have taken their technological decisions as a function of the same favorable conditions, resorting to pragmatic solutions, to the indiscriminate importation of techniques and with scant innovation.

3.- To this has been joined the disinterest of the principal classes and institutions for investigation, invention, innovation, the most efficient methods of production and organization, the spirit of innovation and enterprize. For various reasons and with different practices this has been the case of the old oligarchy and the new elite oligarchy; of the national industrial bourgeorsie; of the middle classes not linked to intellectual or academic tasks; of the workers and marginal city dwellers; of the peasant class.

4.- The cultural-ideological tendencies and patterns have turned out to be disfavorable to investigation and innovation: traditionalist conservatism; modernized conservatism (developmental, scientific and techno-bureaucratic); neofascism; national-populism; the official dogmatic version of Marxism.

These tendencies oppose and fight one another, but they also converge, coincide, influence, and cross-pollinate one another. They have coincided in promoting or accepting irrational elements; authoritarianism and sectarianism; rejection of critical thought and effective pluralism; Reductionism in theory and practice; mythological visions of national and international realities and problems. They have converged above all in the production of negative results. They deteriorate or destroy favorable conditions and foci of creation and innovation in ideas, knowledge, values, techniques, options. They frustrate and alienate critical and creative personalities, reinforcing tendencies for internal and external exile. They extenuate, become trivial, they stagnate culture, science and technology. They operate as instruments--deliberate or involuntary--of social and political regression.

VI.- In the most important Latin American countries. the State is responsible for almost all efforts of scientific investigation and technological innovation. At the same time, in almost all cases, the State appears as an expression of disinterested or hostile forces with regard to scientific creation and technical innovation in conditions of autonomy and as a function of a strategy of authentic development (10).

Indirectly, the State falls short in the way in which it reflects, respects, consolidates, the negative forces and structures for scientific advancement: dependence, latifundio, substituting-subordinate industrialization, rigid social stratification, general tendency to conservatism, minority monopoly on cultural centers, lack of respect and liberty for creative activities, a range of repressive and persecuting forms.

Directly, the structure of power, nature, and the comportment of the State, contribute to determine:

-the scarcity or null availability of governors and administrators gifted with illustration, formation and preoccupation with the protection of science and technology, adequacy for the management of their problems;

-lack of or weakness of demands and support of poles of investigation and innovation;

- scarcity of political, legislative, and administrative creation of conditions for stimulation of scientific development;

- no preoccupation for activities, problems, people and institutions which are perpetuated with science and technology;

-non-existence or rudimentary development of an institutionalized complete system of promotion, coordination, stimulation and direct participation of the State.

The faults and limitations of state action are particularly exemplified in two of its fundamental aspects:

a) The educational system at all levels, but particularly in the university in crisis.

b) The insufficient or inadequate use of the sector of public enterprise, which impedes them from operating as autonomous actors for scientific progress, and as creators of supply and demand for science and technology and for the Private sector in these same spheres.

Because of its direct and indirect behavior, because of its actions and omissions, the State in the majority of Latin American countries does not found foci of scientific creation or technological innovation, nor does it stimulate itineraries of propagation. It does not contribute to the constitution of a social and political environment for maximizing the yield and benefits of science and technology. It does not favor the emergence and activity of motor-subjects. It expresses, accepts or reinforces conditions, factors, and results of backwardness and dependence.

In the best of instances, it changes things as strictly as necessary so that they continue as they are, with insufficient readjustments and delays, contrary to necessities, requirements, and possibilities of national and international reality.

VI.- The diagnosis of backwardness and dependency should be accompanied by the determination of a politic bodyas a joining together of interventions, decisions, and activities of coexistent powers in the society which are articulated, integrated, and optimized by and through the State. and join in stimulating the investigation, innovation, rational application of its products to the objectives of the model of society desired and the strategy of development which is adopted.

The necessity of a scientific body politic stems from the insufficiency of the spontaneous actions of the private groups, and from the necessity of arbitrary and promoting intervention of the State. It embraces decisions which choose from a range of alternatives. It presupposes a nation of progress, a scheme of society to maintain or reform, or to modify or replace. It benefits certain organizations and groups, in an unequal manner with regards to others which turn out to be left behind or damaged. It gives priority to certain advancements, foci of formation, itineraries of propagation, methods ofconcretion. It assigns scarce resources to obtain results selected as desirable. It attempts to respond to basic questions: What science and technology are good? For what and for whom? How many? How can they be achieved and used?

For countries such as those in Latin America, the unfolding of critical and inventive spirit is fundamental, along with the application of original guides, the rejection of servile imitation and the mechanical application of imported schemes, for the achievement of solutions adjusted to the regions themselves and to the conditions of the region, as well as the requirements of a possible new international order. There is no significance in their proposing a mere narrowing of the gap which separates them from the great powers and advanced countries , in order to compete with others, to achieve parity or supremacy. The model of the so-called developed countries--capitalistic or state systems of centralized planning--is critical. The multiple implications (economic, social, political, cultural--ideological, of civilization) of the Third Scientific-Technological Revolution, owing to its velocity, its intensity and profundity, are only refently beginning to be perceived, and they still have not had the rigorous analysis and the more or less precise evaluation of their consequences and implications. For Latin American countries it would be a question of creating the possibilities for cash investment at certain levels and aspects of progress already legitimately achieved in the contemporary world, of discriminating and separating from others of doubtful value or certain danger, as part of the effort for design and in order to realize alternative models of society and development.

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THE SWEDISH CIVIL ENGINEERING PLAN

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SESSION 4B

GROUP II
UNIVERSITY PROGRAMS

REVIEW OF EDUCATIONAL EXPERIENCES IN ENGINEERING IN YUGOSLAVIA

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On the territory of Yugoslavia (about 20 million inhabitants) the organized engineering and technical education started at the beginning of the 20-th century.

In Belgrade, which was the capital of the former Serbia Kingdom Technical High School was founded in 1863. Two more schools, in Zagreb and Ljubljana, were established in 1919 and 1920. It was after the first World war and after the three main nations - Serbs, Croats and Slovenes - were united into a SHS Kingdom.

The organization in these schools was similar and so was the capacity. It is important to mention that before this time the engineers and tecnicians were educated at different universities or technical high schools. The part of the engineers got their diplomas at schools in Vienna, Budapest and Prague. The other part - belonging to Serbian population - were the students at French or Russian schools, in Paris, Moscow or Kiew. This division in engineering education before the first world war was mainly due to the diplomatic relations which existed between Slovenes and Croates with former Austro-Hungarian Kingdom and between the Serbian Kingdom and France or Russia. This orientation today still exists.

To get the idea of the organization of such a technical high school let us see the technical high schools in Zagreb.

At the beginning, in 1919, there were 5 departments: civil engineering, architecture, mechanical and electrical engineering, technology and shipbuilding engineering. In later development 3 other departments were foreseen - surveying, commerce and safety engineering.

The first teachers were engineers who mostly graduated at Austro-Hungarian engineering schools but a great number of professors (not only in Croatia, but also in Serbia and Slovenia) were Russians, among them should be mentioned professors - Timoshenko, Hlitčijev, Ruskij, Bilimovič, Plotnikov, Čališev, etc. Immediately after the establishing the Technical High School in Zagreb several departments and laboratories (which were used bu all departments) were formed. Although the political situation in the country was not very convenient for developing the technical foundation for further growth of the country - the social sciences were at that time prefered - but the technical high schools justified their existance and generally they steadily developed in all the country. To show this in numbers: at Tehnical High school in Zagreb - in 1919, the first year of teaching there were 255 students. In the whole country three high schools were attended by 950 students.

Very soon, in 1926 already, because of the financial reasons, the high schools were transformed into colleges and joined to the universities in Zagreb, Belgrade and Ljubljana, but without any essential changes. The number of students increased steadily , and already at the time between the two world wars a great deal of engineering work (civil engineering, mechanical engineering, shipbuilding) was done by engineers educated at home. The engineers educated at home very soon took over the teaching at technical colleges. Between 1930 and 1940 a very good generation a very good generation of engineers graduated at three colleges. This generation played a very important role during the war, and especially after the war, when the territory of Yugoslavia was heavily destroyed. Only about 40% of the railway system remained, about 40% of houses was completely destroyed and there was about 8% less population than before the war. These numbers show us that it is important to have the technical staff, because about 5-10 years after the war the whole country gained the living standard higher than before the war. And almost no interventions and help from the outside.

It should also be mentioned that the activities at the technical colleges in three capital cities were completely reduced during the war - very few students and in fact no staff - the different armies were settling in laboratories, lectures and staff-rooms - so that at the end of the war only one laboratory for testing the materials remained - to test the materials for the whole country. In 1949 the laboratories in Belgrade and Ljubljana and a new laboratory in Zagreb were restored and equipped in such a way that the normal work could start. The same also happened in other fields of enginnering. Immidiately after the war (1945) the number of students increased immensely and since then a steady growth has been present. With the rising number of students the number of teaching and administrative staff also increased, and this was the reason for splitting the technical colleges into smaller units. This happened in 1955 and at the main cities the technical faculty was divided into four or five colleges: architecture, civil, mechanical, surveying engineering, shipbuilding engineering, electrical eng., technology, geology and mining.

Later, in 1960-65 the further separation was carried out - architectural faculty, civil engineering and surveying faculties. In this way, seven technical faculties are the foundation for engineering education at the universities an the main cities. In the meantime, from the 1950, in other Republics of Yugoslavia, universities with various colleges were founded - at Sarajevo, Skopje and Titograd, as well in two other provinces - at Novi Sad and Priština. In the time from 1960 to 70 also bigger cities in all parts of the country showed the ambition to open either separate faculties or complete universities, however always following the scheme, which was carried out in Belgrade, Zagreb and Ljubljana. Most of these faculties were largerly supported and got the teaching help from the three more experienced faculties.

The today number of engineering colleges is about 50 and among them the dominant are civil, mechanical engineering and technology.

To get the general idea in what extense the number of students and diplomas increased in last 50 years a survey was made for technical colleges, table 1.

At the moment the author hasn't got numbers for the whole country but an estimate could be made.

	1919-44	1944-56	1956-68
Average per year	300	1100	3000

2. Teaching possibilities and methods

It is clear enough that the way of teaching depends on the teaching staff. In the first years of technical high schools in Yugoslavia there were a lot of Russian professors and it is obvious that the basic knowledge was given in the way as it was done at that time (about 1920) in Russia: solid foundation in mathematics, from the applied mathematics to the theory of continuum media, hydraulics, thermodynamics, electricity, structure theory, physics, chemistry etc. The main characteristic - starting with most simplified applications and going to more complicated ones. In other words, it was the inductive way of teaching with a strong emphasis on practical application.

At the beginning the theoretical explanations in lecture rooms were followed by laboratory excercices and laboratory work only with few subjects, because laboratories were not well equipped and there were only a few laboratories. This kind of teaching was, in fact, reduced to the demonstration in front of the whole class, practicaly no individual work was done. No more than 5% of school hours - average for all technical colleges - were alloted to laboratory exercices. It was , in some way, different at the different faculties - more laboratory work at technological faculty. But , how time passed, more laboratories were established and better equipped, so that there are today various ways to demonstrate with models, on the machine, with chemical experiments and testing methods, the behaviour of technical material, but still one cannot be satisfied with number of hours students practise in laboratories and at the sites. At the moment they spend (from the number of lecture hours, at the Civil Engineering Faculty e. g. 3500) only 200 to 250 hours in laboratories, visiting sites and finished structures. There is a more chance to work in the laboratory if the student choose the graduation thesis in the fields where model testing, test rasult of the materials and on the structures are practiced. In this case the student can stay in laboratory longer by 250 hours.

The situation is a little better at some other faculties e.g. mechanical engineering, technology, electrical engineering etc. Lecture rooms usually haven't got any special equipment - at some lectures an overhead projector may be used. It seems that there within the teaching staff is no need to use modern educational means as e.g. slides, film-projector, or other audio-visual aids.

The full-time studies at faculties has several times changed in last 30 years - from 8 to 10 terms, each term lasting 14-16 weeks. The number of lecture hours per week also changed from 40 to 30, because a shortening of working days from 6 to 5 was introduced about 15 years ago. Today, at the most technical faculties the length of studies is prescribed to 9 terms. The last term is foreseen for work on the graduation thesis and for sitting for the last exams.

If we take into account these time-tables we get approximately 3500 hours, about 40% alloted to lecture hours and 60% to auditorial and laboratory exercices and individual work.

Although very strict measures are undertaken to make students graduate in 4 1/2 years, only a small percentage does it. 5 1/2 years is at the moment the average at technical colleges. The reasons: still a too liberal relationship student-college. In many cases, when a student has no support from his family and has no scholarship, he is forced to earn his living. And the last reason: the teaching programmes and teaching possibilities are not standarized enough.

However, it seems that the generations of engineers who graduated in Yugoslavia (only a very small number graduates abroad) went through a good training and acquired good knowledge of engineering science, what is proved by increasing capacities in industry, civil engineering, power potential,etc., in the country. Many Yugoslav enterprises and factories have also a very good reputation obroad - in European countries, at the Near East, in East European countries, and also in South America and Africa.

Beside full-time studies, part-time studies are organised at many colleges - these are usually evening schools or seminar studies. The programme is basically the same or similar to the programme of the full-time studies. Perhaps the criteria at the exams is a little looser.

Also to mention: the number of students in the first year of studies was limited until 1977. Only those who passed the entrance examination (mostly mathematics,physics chemistry, etc.) were admitted to the college. More than 60% of these students graduated in an average time of 5 1/2 years. In 1978 the entrance examination was partly changed, giving preference to students who acquired a scholarship at factories, enterprises,community services etc.As a result of this change, a greater number of students was admitted to the first year (a situation we already had 15-20 years ago). It is intended to decrease the number of students after the first term by exams in some basic fields - mathematics, physics, chemistry. This in some way replaces the entrance examination. It should be mentioned that similar trends are observed in many other European countries:Germany, Austria,etc. It seems that there are problems in balancing the number of graduate engineers at high schools and the demand for engineers in the country. At the moment, in Yugoslavia there is a lack of civil, mechanical, electrical engineers, and a surplus of architects,mining and technology engineers. Surveying is limited to general mapping, while mining or civil engineers are generally employed for measuring in civil engineering.

3.Higher Degrees

The specialisation usually begins at the third year of studies and it is continued to the end of the studies. The degree of specialisation depends on the faculty. Some faculties have only a few orientations e.g.at civil engineering - there are usually:structural, hydrotechnical,traffic and technology with organisation. At some other technical colleges there are more orientations and specialisations. Students quite often finish first two or three years at some smaller college and continue studies at the colleg with a larger choice of specialisations. It is usually a faculty with longer tradition and broader choice of specialisation courses. At the beginning of the 70-ties the courses for master's degree were introduced according to the law of high education. These are two year courses comprising a quite large quantity of lecture hours - sometimes 400-450 in two years - and finishing with individual work.

At first the programmes were mainly theoretical because the courses were considered as a preparation and a foundation for the scientific work, in fact it was the first step to doctor's degree. Experience showed that only a small percentage of students had finished their studies and gained the master's degree - not more than 20%. There are many reasons for this. The first and the main reason:only very few attendants had enough free time to attend lectures and study. Due to this fact the number of lecture hours was decreased and the number of different specialisations increased. In this way, a spectrum of varieties enables students to choose what they are interested in. There were attempts to organize the postgraduate studies not in order to get the master's degree, but as a kind of specialisation more or less practical, not preparing candidates for a doctor's degree. Anyhow, the interest for such courses was small or none. The reason: the qualification does not give any preference in social status. There are, at the moment, intentions of introducing such "specialistic courses" at technical colleges, as there is a long tradition at the medicine colleges, but not in the form of formal courses, but as a training under the supervision of the specialists in various fields. It is not easy to organise such training in technical fields because the locations are scattered and the training man-to-man could be realised and not e. g. as in hospitals a man-to-a-group. There are possibilities to organise such trainings at institutes, e.g. for testing materials, or design offices, work shops etc.

4. Possibilites and realisations outside faculties and high schools

Since the end of the second world war more intensive "refreshing courses" and "specialist"courses have been organized at the "Association of Engineers and Technicians" in all the republics of Yugoslavia. They have been mainly held in winter months when are not generally so intensive as in other months. They usually last two weeks with a fixed lecture programme and the laboratory or site work. Although these courses were thought to give the attendants the latest experiences and knowledge from the practice, it seems that it is not easy keep up with the progress.

There is generally a great difference between people employed in enterprises and workshops, busy with daily work and problems, and the engineers working in scientific institutes, schools and colleges.

It should be mentioned that there is greater number of the first ones and certainly an organized education may help a lot to overcome the gap and to get more educated engineering staff.

It is the same for all degrees of qualifications, the workers get their experience mainly through work at sites and workshops, when they pass some exams then they go to higher qualifications. They often go abroad to work. They acquire skill and experience through work and only a small number get it through organized education.

There are, in Yugoslavia, exames for different levels of qualificitations. It is differently organised in different republics. In some, the exames committee consists of members of one workshop or enterprise, in other republic exames are appointed by an official body - council, executive board, etc.

5. New trends and experiments

In education at all levels and in all fields (social sciences, biology, technical sciences, etc.) a new programme is established. It is a kind of permanent education. After finishing the eight year primary school youngsters attend schools for general education for two years. They lern languages, mathematics, physics, biology, and social sciences. Next two years they attend special schools - engineering, handicraft, practical applications etc. Every two years the candidate gets a higher degree - to the highest scientific and practical level.

At the moment this reform is already carried out in secondary schools and the results are not yet visible. Although the grading in education has certainly many good sides there are many problems in organizing such teaching and education, but in a few years there will be some results - to judge the failures or succeses.

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1952 - 56 member of RILEM Central Board, President of Yugoslav Society of Mechanics, member of Scientific Board of CISM, member of ISO - committees, etc.

SOME EXPERIENCES IN CONTINUING ENGINEERING EDUCATION IN LATIN AMERICA

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Introduction

In 1925 the Mexican Government created a number of agencies to be in charge of planning, building, and maintaining public infrastructure works. At the same time, as the highway network expanded, the number of hydraulic works increased, and urban development was intensified in this country, the higher education institutions offering engineering courses adopted new strategies and modified their curricula at the bachelor's degree level, in order to meet the growing demands for professionals in different branches of engineering.

In about the year 1950, Mexico started to industrialize. The population began to concentrate in the cities, with heavy migration from rural areas. The population centers located in small and large cities transformed Mexico's rural image, initiating the change to an urban society. Those who were responsible for elementary, secondary, and higher education could not remain outside these currents of growth and development. Consequently, in order to meet the new demands, the system of higher education began slowly to introduce changes into curricular structures, educational objectives, and the principal and lateral egresses from undergraduate studies.

This country's technological advancement led to the creation by the national educational system of mechanisms for achieving specialization, particularly in the various branches of technology in all their manifestations. However, the potential users of the new opening in technological education did not obtain access to the opportunity for either specialized or postgraduate studies, due either to their socioeconomic limitations, lack of time, or even a marked lack of interest. This prevented the growing number of professionals who had graduated from engineering schools to up-date their knowledge, and as time passed, because of scientific advances and conditions associated with forgetting, there was no mechanism for overcoming obsolescence of knowledge.

Towards the end of that decade, postgraduate engineering studies received a strong stimulus. In the decade 1960-1970, the demand for up-to-date specialists and professionals in some of the engineering disciplines increased because the country's industrialization solidified development, and particularly because conditions were favorable for the people's economic development.

The need to have available not only a considerable number of engineering school graduates, but also a growing potential in specialized manpower, brought out the serious limitation occurring when professional knowledge becomes obsolete.

Within this range of ideas, and due to the impact on the Mexican intellectual panorama of dissemination of the philosophical concept of continuing education, strong currents of opinion were generated in favor of the institutionalization of mechanisms to ensure that obsolescence of both academic experiences and knowledge could be overcome.

Continuing Education in the School of Engineering of the University of Mexico

Formal programs for continuing engineering education in Mexico began early in this decade when, by a decision of the Technical Council of the School of Engineering of the University of Mexico, the Center for Continuing Engineering Education (CCEE) was established as a part of the School's Graduate Division, in July 1971. The site chosen was the Mining Palace, at one time the site for the old Royal Mining School and later for the National School of Engineers, and the cradle of Mexican engineering.

From the time it was created to the present, about 450 courses have been given, attended by more than 15,000 engineers. The courses can be divided into three categories: the first includes those designed to serve the needs of private and governmental enterprises, agencies, and institutions seeking support from the University of Mexico's academic experience (institutional courses); the second includes open courses directed towards anyone interested in being trained or acquiring knowledge about certain subjects; and the third includes courses of specialization in which, by strict compliance with certain requirements, credits can be earned towards a master's degree.

Continuing education for engineers is a real novelty in the teaching-learning process, since the methods, systems, and procedures in the transmittal and reception of educational messages are directed towards meeting the expectations of those who, because of their age, socioeconomic situation, and the rank they hold in their organizations, require special treatment in order to return to formal education.

In 1975, the CCEE intensified its research and publication activities, making a qualitative leap by means of the system of remote, personalized education. This strengthened the prestige of continuing education in Mexico and facilitated access to it for a considerable number of professionals who, because of a variety of limiting factors, could not attend classes in the Mining Palace.

In 1977, the CCEE's publishing facilities made it possible for the experience of outstanding professionals to be transformed directly into manuals, books, notes, and tests which support the learning process. Engineers and professionals from other disciplines making use of the CCEE began to find that the Mining Palace was not only a magnificent architectural monument constituting a cross section of the purest neoclassic style, but also provided the optimum conditions for establishing new professional relationships, better cultural horizons, and above all, an authentically humanistic dimension.

A summary is given below of some general aspects of the CCEE's experiences in the seven years since it was founded.

Methods for Analyzing the Needs in Continuing Education Programs

This activity is carried out through:

a) Direct contact at top decision-making levels in official and private institutions employing engineers in considerable numbers.

b) Specific consultations with professional associations and colleges of engineers and related fields.

c) Specific studies of manpower needs conducted by the University.

d) Direct consultations with professors and alumni.

Techniques for Promoting Continuing Education Programs

In general, this activity is carried out through:

a) Preparation of an annual brochure, giving the schedule for the whole year.

b) Preparation of specific brochures containing detailed information about the objectives, subjects, professors, costs, and other pertinent information for each of the events indicated under point a).

c) A specialized directory, which is constantly revised and updated, containing the names, addresses, and areas of interest of 20,000 engineers, architects, and members of related professions. The participants in all courses are automatically included in this directory.

d) Announcement of forthcoming activities in professional journals.

e) Newspapers and other general communications media, with use also made of the University's own media (radio and periodicals).

f) Preparation of a poster showing each month's events.

Costs Associated with Continuing Education Programs

Every event is handled as a project. A budget is prepared covering direct and indirect expenses, which provides an estimate of the number of participants required to cover the cost and a payback quota is set. Self-sufficiency is sought in all cases. In Table 1, a breakdown is given of items and percentages for a 40-hour continuing education course with Mexican professors.

Table 1.
General Budget for an Open Course

Item	%
1. Fees for professors and consultants (including coordination)	18

Item	%
2. Teaching materials	19
3. Promotion: newspapers, brochures, and posters	15
4. Certificates	2
5. Refreshments and social event	1
6. Rental of equipment	1
7. Copies and transparencies	4
8. Rental of classroom	2
9. Miscellaneous expenses: stationery, telephone, electricity, water, gas, etc.	4
10. Maintenance of office facilities and depreciation of equipment	7
11. Direct administrative expenses: salaries and fringe benefits	26
12. Contingencies	2
Total	100%

Latin-American Panorama

Latin-American countries with closest ties to Mexico, through the affection felt among sister nations, in view of the potential for technological education in these countries, sought an approach by means of which there could be a sharing of experiences, criteria, and technologies.

In keeping with its basic philosophy and the principles on which its autonomy is based, the University of Mexico wished to respond to these proposals for sharing with deeds. It therefore organized several exploratory events with sister countries such as Ecuador, Guatemala, Colombia, Costa Rica, and Peru.

Worth highlighting, however, is the program conducted in collaboration with the Guayas College of Civil Engineers, in Ecuador. Under this program, four or five courses are given per year, taught by the most outstanding Mexican professors. Since the program was started in 1974, sixteen courses have been given, with an average duration of 32 hours per course, and the participation of more than 1,600 Ecuadoran professionals. In 1978, the University of Santo Domingo, located in the city of Guayaquil, was incorporated into the program.

The initial explorations revealed that there has been an intensive acceleration of continuing education in Latin America, but with the serious limitation that no methodology can be seen that fully meets the increasing demands for it, particularly in the field of engineering.

The Latin-American countries' rate of economic growth does not correspond to the fast population growth, and consequently does not meet the demands for housing, clothing, food, hygiene, and access to culture. These aspects are closely linked to the process of planning, building, and maintaining public works to provide the infrastructure, housing and urban services, and to other branches of engineering.

Moreover, the development of communications, electronic, and systems engineering has led to further intensification of the problems, because prior to 1960 not all the engineers graduating from engineering schools had the up-to-date knowledge and experience required to operate methods, systems, and procedures of different types required by industry, construction, and the demand for services.

To the above panorama must be added the progress that occurred in the field of sanitary engineering after 1960. The degradation of ecosystems, together with the problems derived from the lack of planning to prevent environmental pollution, were other aspects that contributed to intensifying and making more acute the lack of specialized technicians.

In order to save time, a summary of the phenomenon can be made on the basis of modernity and the extraordinary advances in the different specialities that make up engineering activities.

The great majority of Latin-American countries, with some differences in the time span, were faced by the same problem, with a growing demand for continuing engineering education seen in all of them.

In our case, the series of encounters with continuing education institutions now existing in some countries facilitated the acquisition of points of reference, and we must admit that they also allowed us to discover some educational innovations.

From what has been observed so far, other countries also have considerable experience. It is to be found in different places, and the possibility of access to it is made difficult by distance and the lack of institutionalized mechanisms for sharing this experience.

The occurrences mentioned above represent the cristalization of the first effort. It is now up to us to take advantage of the occasion offered by the First World Conference for Continuing Engineering Education to generate the methodology and systematization required to establish channels of communication, provoke interactions, encourage shared activiities, and perhaps even analyze the possibilities of lowering costs through joint efforts.

Within this range of ideas, there is an urgent need to renew the efforts of solidarity that unite us and consciously, responsibly, and enthusiastically present a proposal to the Resolutions Committee of this Conference: that the Latin-American Conference for Continuing Engineering Education should be institutionalized. A Conference of this size would not become bureaucratized, because the site for it would be moveable, its officers would be changed periodically, and it would not involve any budgetary commitment, but it would amply facilitate the execution of shared projects conducted as joint efforts.

The seat for the Latin-American Conference for Continuing Engineering Education would be the country designated by the assembly, where a technical secretariat would function, but the participating members-at-large would have the obligation of seeking to achieve the objectives assigned to the Conference. Among these objectives, the following should be stressed:

- Planning and organizing the sharing of experiences, starting with the creation of a documentary center in each country specializing in continuing engineering education.
- Installing, through a teleinformation system, terminals that would facilitate access to systematically organized repositories, for the purpose of strengthening the educational technology of continuing education.
- Generating instruments for rapid, timely, suitable international communications as an aid to the attainment of the above objectives.

The person elected as President of the Conference would be responsible for seeing that those who voluntarily commit themselves to participate in it shall unselfishly and without quibbling contribute their experiences, share the results of their research, exchange curricula, and intensify internationalized production of printed material in which the approach is that of continuing engineering education.

A second stage, after the Conference is set up, would be the establishment of the Latin-American Institute for Continuing Engineering Education and its correspondent institutes located in the cities designated by each country. This structure, which is perhaps utopian at this time, might be one of the few solutions to ensure harmonious functioning under the immense umbrella of continuing education.

We believe that through either the Conference or the Institute, there would be intensive participation by universities, politechnical, and technological institutes, and in general, centers for higher education where any of the specialized branches of engineering are taught.

To withdraw from the universities, which has become a characteristic, in modern times, of mankind's intellectual trajectory, would be to condemn both the Conference and the Institute to a deplorable failure. This proposal should be endorsed by those who, because of their rank and from the legal standpoint, bear on their shoulders the grave responsibility of combatting obsolescence in knowledge -- a fight to which we all should be committed.

In presenting this paper, I request, both personally as a participant in this Conference and in my role as a member of the university community, that these proposals be included among the resolutions adopted.

In the above circumstances, I agree with Ortega y Gasset that technology cannot exist without humanized intellect, nor can humanized intellect exist without technology.

Conclusions

1. The World Conference of Continuing Engineering Education should propose mechanisms to continue doing research, conducting studies, and carrying out educational projects, both scholastic and non-sholastic, so that the principal definition of the meeting being held in Mexico City will be the creation of participative instruments at the Latin-American level to extend in time and space the fruits produced here.

2. It is suggested that the resolutions adopted by the Conference should include an initial attempt to define the objectives, policies, functions, and programs for the operation of a system of technological-educational exchanges with the voluntary participation of those registered as representatives of universities and institutions of higher education, or on their own behalf, in order to create an American Conference of Continuing Engineering Education, with its seat to be determined by the final plenary assembly.

3. Psychopedagogical, pedagogical, academic, educational, and didactic esperiences derived from the operation of teaching-learning systems in continuing education should be shared among the centers where it is utilized, at the regional, national, and international level, in order to enrich the store of knowledge in this field and make available points of reference through which costs can be lowered, results optimized, and new opportunities created for extending and intensifying the use of continuing engineering education.

4. The similar nature of economic development conditions in many Latin-American countries makes possible the harmonious use and appropriate application, through the necessary adaptations, of continuing education technologies, provided that the study curricula are linked directly to the solution of the particular problems affecting each Latin-American region.

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INDUSTRY-UNIVERSITY RELATIONS FOR A SUCCESSFUL PROGRAMME

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Summary

The following paper describes the methods used by the Engineering Faculty in the University of Surrey to develop continuing education in the form of short courses and Higher Degree courses and the philosophy concerning industrial liaison essential to these activities.

Introduction

In Britain, University engineering courses at undergraduate and postgraduate level were introduced with the express objective of educating leaders for industry. For many years large Companies, like Metrovicand British Thomson-Houston, supplemented these courses with practical experience through their Graduate Apprenticeship schemes. Engineering is, of course, a comparatively new University discipline. Some would say, in fact, that it is only now beginning to achieve academic respectability, despite its undoubted importance as a profession for many centuries. Other countries have also adopted the academic ideal that the mind can be developed only through one of the traditional intellectually demanding disciplines. It has taken a long time to realise and accept that this ideal can still be achieved, and an academically acceptable University course can at the same time be vocational and equip students for careers in industry and commerce.

In many Western countries no attempt was made to fit engineering courses into an existing University framework, and special establishments were set up to teach engineering at a very high level. In the United Kingdom, however, Departments of Engineering were created in most Universities as they have grown up over the past century or so, but it is only since the end of World War II that their importance to the nation has come to be recognised by Government and society, and a special effort has been made to strengthen them, and to emphasise the need to increase their contribution to a modern, industrially-based society such as Britain.

In the late 1960's several Colleges of Advanced Technology were raised to University status as Technological Universities. These colleges already had a long history of teaching practically-orientated engineering courses, and had been responsible for educating design engineers as well as technical craftsmen. They were able to combine the necessary scientific fundamental theory with engineering practice - a combination essential to good engineering.

The University of Surrey is one of this generation of British Universities. Its Charter expressly states that collaboration with industry should occur at all stages in the teaching process, and in all activities of the constituent departments of the University. This paper describes some of the ways in which, by collaborating with industry, courses and curricula can be developed to meet the ever increasing need for continuing education in any rapidly developing discipline.

The Need for Continuing Education

It is of crucial importance that education in engineering beyond first degrees level should be both relevant and applicable to the students' careers. No matter how good the liaison between a University Department and industry may be, it is never easy to define industrial requirements and develop the courses to match them.

An industrialist or businessman recruiting a raw graduate engineer has certain basic requirements in mind; the ability to assimilate new techniques, and to analyse and synthesise systems, some of which will be novel; personal qualities including the ability to work in a team, and to communicate ideas and findings verbally and in writing. These requirements must be kept in mind at all stages and levels in the educational process.

Among the aims of any course are the following:-

a) The development of a critical approach to engineering and scientific problems.
b) The provision of a sound knowledge of underlying principles.
c) The provision of knowledge of current practice.
d) Creation of an awareness of associated problems and techniques for their solution in areas.
e) An introduction to the sociological implications of the field of study.
f) The development of an ability by using one's own resources.

g) The development of individuality and ingenuity.

The last two involve personal qualities and abilities which vary with the individual and are, of course, impossible to plan. However, the University experience at any level at least provides the atmosphere in which these qualities can grow.

The first two are probably more applicable to undergraduate teaching than to postgraduate or continuing education. But newly graduated engineers, who are undoubtedly well-versed in their relevant subject matters, and competent to use their knowledge in design and development work, quickly come to realise that there are gaps in their knowledge when they are forced to apply themselves to industrial problems. Not all degree courses cover the same subject matter, none can possibly cover all subjects, and many teachers are inclined to concentrate on areas they have made their own specialty. A certain amount can be done to fill these gaps from their own resources, but the need for the provision of opportunities for continuing education in the form of up-dating and refresher courses quickly becomes apparent. (The number of in-house courses provided by the larger companies is an indication that this is well understood.)

Aims c), d) and e) most certainly apply to continuing education. In a rapidly progressing field such as Electronic Engineering, current practice changes continuously, and the content of an undergraduate course syllabus may well be outmoded within five to ten years. Courses to update knowledge of particular specialisms are clearly essential.

The interdependence of the different branches of engineering is becoming more and more apparent. For example, electronic instrumentation and control is playing an ever increasing part in mechanical and civil engineering, as well as in research in pure science and life sciences. There is a proven need for courses to help industrial staff to acquire an appreciation of other disciplines, and how the techniques these disciplines offer can help them in carrying out their duties. Discussions with industrial companies have confirmed this view.

Finally, one must examine areas which, whilst they are of great importance to industry, may well be too advanced for first degree study. It is difficult for an undergraduate student to appreciate fully the importance, for example, of a systems approach to his subject, or advanced business and management techniques, when he has had no experience of any of these. But when he is a few years into his career, this knowledge may be essential and, where better to study than at a University where appropriate courses have been developed in consultation with industry?

Continuing education is equally important for University teaching staff: if a University is to satisfy course aims and objectives, it is obvious that the staff involved with teaching, including continuing education courses, are aware of the changing requirements of industry. University staff must therefore interact as comprehensively as possible with their counterparts in industry. This can best by done by genguine involvement with real life industrial problems, and searching out the opportunities to make a genguine and useful contribution to the business of the companies. It is important to remember that the deletion of obsolete and redundant material from University courses is as necessary as the introduction of new materials, and close contact with industry helps to highlight this. At the University of Surrey we have successfully developed opportunities for continuing education in several different ways: through Masters' courses, short, intensive courses, and higher degrees through collaborative research. Close industrial contacts are maintained via the appointment of visiting staff from industry, staff interchange, and making industrial experience in the form of project work an integral part of courses.

Some examples of courses in our current postgraduate prospectus, and the experience acquired whilst planning and presenting these are now described.

Masters' Degree Courses

The Faculty of Engineering offers several M.Sc courses, but the Systems Engineering Course run by the Department of Elctronic and Electrical Engineering has been the one chosen for consideration in some detail in this paper.

Some ten years ago two courses, one in Control Engineering and one in Computer Engineering, were combined, and the resulting course introduced a systems approach to these fields, covering scientific principles, techniques of mathematical and statistical analysis and synthesis and up-to-date engineering practice. This proved a successful formula for several years.

With advances in the field, and as much of the original material was incorporated in most first degree courses in electronic and electrical engineering, the Masters' course became more of an in-depth study.

The course was taught mainly by staff of the parent Department but, where necessary, expertise was brought in from other Departments, and, in particular, staff from the nearly Research Laboratory of a large multinational electrical company were beguiled into helping with the teaching. Industrial advice was sought during curriculum development, and largely as a result of this, an optional telecommunications module was added. Most students were graduate engineers with several years industrial experience, and were supported by either government grants, or by personal means.

In the mid-1970's there was a significant recession in British manufacturing industry, with the inevitable accompanying cutback in government spending on higher education, and grants became scarce. To cope with this difficulty, it was decided to offer the course part-time as well as full-time.

The arrangements involved splitting the subject matter into two parts, each taught on different days of the week. Full-time students could take both parts and spend the rest of the week consolidating by private study. Part-time students, by taking only one day away from work each week, completed the academic content of the course in two years. The arrangement proved a great success, since many industrial companies are prepared to give staff day release whereas a complete year would be out of the question. Student numbers have increased, and several companies have commented that the stimulus of spending a day a week at University has resulted in higher quality work.

In response to the increasingly important role played by microprocessors and desk top computers in systems engineering, modules in microprocessor technology and applications have lately been added to the curriculum.

At the University of Surrey great emphasis is placed on the training of engineers through practice as well as theory, and all M.Sc students must carry out a three-month engineering project,after successfully completing the academic part of the course. The project consists of technical and general planning, design, construction and evaluation work, a demonstration of understanding and a final technical report. Most projects are carried out in industry, the University stipulating that the project can be satisfactorily completed in three months. University and company staff, jointly agree the project title and content, and jointly supervise the student's progress. The projects often provide the company with significant and useful results, and the University supervisor benefits from first hand experience of a real industrial problem - a benefit ultimately reflected in this teaching.

Short Courses

In Britain industrial companies are encouraged, often by government training grants, to send staff on short, intensive courses organised by approved institutions. Such courses do not attract direct funding from the University Grants Committee, so in general must be financially self-supporting. They must therefore meet the needs of industry sufficiently well to attract students in reasonable numbers. Short courses vary in duration from one day to three weeks, and commonly have a follow-up course some time - perhaps a year - later. We have found that employers are reluctant to release staff for longer than three weeks, and the staff themselves are reluctant to be away from their jobs for longer. So we regard three weeks as a maximum, with a later follow-up if this is required.

These are often up-dating courses in a particular area of study, or broadening courses relating to a change in career pattern. A common example is engineering management.

Short courses are normally held in vacation time, so making good use of University facilities, including the halls of residence, and providing a useful source of income. Surrey has a total of about 3,800 students, two thirds of whom live on the campus. We have been involved in specialist courses, but in addition the Department of Electronic and Electrical Engineering has for the past ten years run an appreciation course in up-to-date electronics.

Originally the request for such a course came from a company who manufacture cigarette making machinery and were concerned about the lack of knowledge of electronics amongst their design engineers - mostly mechanical engineers by profession. Over the years, the course has changed and developed into a unit entitled "Electronics for the Non-Specialist" and regularly attracts the self-imposed maximum of thirty students each year. Course members are usually graduates or the equivalent of several years standing and their status varies from junior designers to managing directors of small companies. The delegates pay a course fee, which covers two books of course notes to the Department, and pay the University separately for accommodation and meals. The Departmental staff who teach the course are paid lecture fees from the income received.

In line with the policy of emphasising practical skills wherever possible, a substantial amount of time is devoted to design experiments, enabling students to learn through practice and to enjoy the acquisition of new skills. The interaction between students from industry and university staff is mutually beneficial. Course tutors make new contacts and discover specific problem areas. Discussions - often long into the evening - sometimes throw light on novel applications of electronics in unexpected areas, and occasionally lead to joint development of new techniques and saleable equipment. In the first few years, students were attracted through advertisements in scientific and technical journals, but most now hear of the course through personal recommendations from previous course members.

Short course activity is expected to grow very considerably in the next few years within the entire Faculty of Engineering, and we understand that more British institutions are investigating ways of using such courses in the process of gaining additional qualifications: this would be an added inducement to students, of course.

Short courses are, however, expensive in staff time and effort. We estimate that each hour of lecturing and laboratory work needs 3-5 hours of preparation. As we said earlier, they usually take place in vacation time and so eat into the time available for personal research and connected activities. They are residential, involving informal but invaluable evening sessions. If the activity is to grow to any extent, recognition in terms of additional staff will be necessary, and University funding should take account of this.

As a general rule, we would not run at the University a course designed specifically for one

Company, but we have permitted staff to give special in-house courses - say for one day a week for six weeks - as part of their consultancy activities.

Collaborative Ph.D's

All Departments in the Faculty of Engineering at Surrey have active research schools. Ph.D's by research are offered in many subject areas, and are normally embarked upon full-time immediately after a first degree, or after one or more years of industrial experience.

We do, however, offer another route to the Ph.D and accept students working in industry, provided that the project on which an applicant is working is of the right standard, and can be guaranteed by his employer to last for at least three years. He is then supervised jointly by a suitable member of the company's staff and a University member.

University research is often criticised by industry for being irrelevant, too long-term, or too speculative, but the collaborative Ph.D project described above is obviously of genuine and immediate interest to industry; any criticism must then be laid at industry's door, since the project is one of its own. Joint projects, where both industrial and University facilities are used by the students, can sometimes be arranged, and these are clearly of great mutual interest.

Collaborative Ph.D's generally take somewhat longer to complete than the traditional form of full-time postgraduate study, especially at the thesis-writing stage, but these students are enormously appreciative of the opportunity to gain a higher degree, and to undertake a really thorough study of a topic, which otherwise might never have been possible for them. It is expected that the numbers registering for collaborative higher degrees will grow as contacts increase between the University and industry. Certainly this type of university research cannot be said not to be geared to the needs of the nation.

Other Areas of Industrial Collaboration

In order to develop relevant courses for a programme in continuing education, as many contacts as possible must be made between industry and the Universities, and the most important and fruitful of the approaches we ourselves have used are now briefly mentioned.

Visiting staff, many of whom hold senior management posts in industry and national centres of scientific research, have been appointed. They advise on current problem areas in engineering and modern industrial technology, and give invaluable help in development of courses. Academic staff are encouraged to make extensive visits to other establishments in return, to learn the newest developments and to contribute actively whenever possible.

Research and development contract work is undertaken by all the engineering departments, and one group in particular, the Industrial Electronics Unit, was set up specifically for the task of providing an R and D service to industry at a professional level. Teaching staff act as project leaders and so are involved with the development of ideas to the prototype stage, or the design of instruments to the customer's specification, and even in very limited production runs. Through this Unit, important and interesting problems are studied and industrial contacts are deepened and extended. The Unit has a current turnover in excess of £200,000 per annum at the present time, and its earnings are used to supplement the research equipment grant, and finance many other departmental and University activities. Less tangible but equally important benefits are reflected in teaching at all levels.

The Future

This International Conference would not be in progress if there there were not international agreement that frequent updating of knowledge,the acquisition of new knowledge and skills, and even career changes will be necessary for all practising professional engineers in the future. This most certainly applies to the United Kingdom.

The rate of change in technology is rapid, and anyone who becomes committed to a narrow specialism will soon find himself redundant. Universities must increasingly become centres for continuing and changing education, whilst maintaining their traditional role as centres of scholarship and excellence.

This needs adaptability and swift recognition of trends if Universities are to be able to provide at the right time courses which allow engineers to become familiar quickly with new techniques.

Curriculum development at all stages, including postgraduate and post-experience, must in future become a continuing process. More short courses are needed. M.Sc, courses, if they are to survive, must offer part-time as well as full-time programmes. In 1978 two new such M.Sc. courses were instituted at Surrey - one in Geotechnical Engineering and one in Energy Engineering Management. Initial support for both is encouraging. In the case of the latter course, a one-day conference was held at the University to enable industry to comment on and to advise on the proposed curriculum. This helped greatly to ensure its relevance to industrial needs. There will be increasing use of industrial expertise in the development and teaching of such courses, and industrial liaison will become even more important as courses are directed towards industrials needs.

There are, of course, other groups involved, apart from those in industry for whom opportunities for continuing education are of vital importance - for instance, schoolteachers. At Surrey we have for the past few years run an evening course in "Electronics for Schoolteachers".

It is hoped that the necessary level of funding will be made available to support the development of our continuing education programmes, and that the effort needed to make these successful will be recognised. In any case, in Britain, industry and the Universities must pool their abilities and expertise to enable engineers to take an ever more important part in the wealth-producing activities of the nation.

NOTE

Dr. Brown and Audrey J. Perkins were unable to attend conference and

Mr. P.J.R. d'Authreau
Course Director
Honours Degree in Engineering
University of Surrey
Guildford, Surrey, England

made the presentation at the conference.

MISS AUDREY J PERKINS

Miss A J Perkins joined the Department of Electronic and Electrical Engineering in 1968, after some years of employment in personnel management and research administration in the electrical engineering industry. She is a Member of the Institute of Personnel Management.

Dr. Gwyn Brown graduated with B.Sc. Honours from Southampton University in 1962 and with a PhD in 1966 having performed a project on Electron Beam Technology. He spent some time at the Royal Aircraft Establishment working on Airbourne Communications before joining the Department of Electronic and Electrical Engineering, University of Surrey. His teaching interests include Circuit Electronics, Semiconductor Physics and Devices, Materials Science and Computer Engineering, with research interests in the fields of Ion Implantation and Device Physics. He has been on various working parties on new courses and curriculum development, was recently Secretary of the Staff Assembly of the University and is responsible for all undergraduate admissions to his Department.

THE WISCONSIN MODEL

John P. Klus
Chairman, Department of Engineering and Applied Science
University of Wisconsin-Extension
Madison, Wisconsin

1. Background

The United States, a country of just over two million people, employed an average of 1,267,000 engineers during 1977. In that same year, a national study indicated that the University of Wisconsin--Extension's Department of Engineering & Applied Science (UWEX-Engineering) was the largest organization of its kind in the country, providing fully 15% of all university-sponsored continuing engineering education.

The breadth of offerings at UWEX-Engineering varies from two-day institutes to three-month evening courses on the electrowriter network (where instructors lecture, answer questions, and communicate through an electronic blackboard with groups of students around the state); from a correspondence course taken by an engineer in Saudi Arabia to a video cassette course in Milwaukee.

During the fiscal year 1976-1977 UWEX-Engineering served 18,000 engineers and related staff. Of these, about 60% came from within Wisconsin and 37% came from others of the United States. Three hundred and ninety-seven came from other countries. 319 of these from Canada. Our department serves approximately 20% of Wisconsin's 26,000 engineers each year.

Historically speaking, the objectives of UWEX-Engineering are rooted in what is described as the"Wisconsin Idea", an educational philosophy set forth three quarters of a century ago by one of our university's most memorable administrators, Charles Van Hise. As the philosophy is usually expressed, "The boundaries of the campus are the boundaries of the state," the university is viewed as a resource to be used for the benefit of all Wisconsin's citizens. This philosophy makes its greatest impact in the extension field, where professional development programs have been offered since the Wisconsin Idea's inception.

Objectives

UWEX-Engineering's mission is to unite the teaching resources and research knowledge of the University of Wisconsin system with the expertise of industrial leaders in order to improve both the economy and standard of living.

Within this broad mission, the particular objectives of the department, as listed in the Annual Report and the Administrative Policy Handbook, are as follows:

1. Provide opportunities for continuing education and professional development of all those who are professionally concerned with science and technology...engineers, physical scientists, architects, planners, technical managers and leaders, and technicians.

2. Structure programming to be both convenient and beneficial to the individual student, permitting faculty guidance to be provided where needed.

3. Emphasize programming directed at current problems, both national and local, of technical, economic, and social concern. Establish and promote technical programs that are in the best interest of industry, our public, and the nation.

4. Make interesting and educational courses in science and technology available at multiple levels in order that: high school and college students may make up deficiencies; and the general public may learn about and better understand many technical and scientific areas.

5. Relate all forms of technical information, knowledge, and research to the needs, as they are perceived, of both technical and non-technical people. Encourage interest in science and technology for all walks of life.

6. Offer technical continuing education to meet any needs that are not being satisfied at present.

Continuing education is presented most frequently as some combination of live lecture, discussion, notes, and reading materials. The combination in each case is designed to meet the students' needs and deliver content with maximum effectiveness. Frequently these forms are influenced or further combined with some of the less common formats and media, most of which can be used to carry the full teaching load in less common circumstances.

UWEX-Engineering works through the following formats, all of which will be described in section 5, "Format:"

Institutes
Short Courses
Workshops
Evening Classes
Correspondence Courses
Electronic Media Programming
    ETN
    SEEN
    Cable TV
    Video Cassettes
The Professional Development Degree

The most popular formats at UWEX-Engineering are the two-day institutes and the one- to three-week short courses, grown from a total attendance of 6,700 five years ago to 14,000 last year. These will be the main formats discussed where the answers to questions will differ for each format.

2. Needs Analysis

Determining needs is the most critical part of continuing engineering education programming. UWEX-Engineering faculty first assess and categorize the types of clientele they are serving and then see what are the needs of each clientele category. Faculty put more than ¼ of their efforts into studying the educational needs of those in the field, keeping track of new technology, new fields of engineering practice, new legislation, and changing national needs.

Geographically, about half the enrollment in UWEX-Engineering programs comes from within Wisconsin; outside of the state enrollment drops off with increasing distance, except for a concentration of enrollments in the highly industrialized and densely populated northeastern U.S. A similar effect is noted on the local scale, with high enrollment concentration near Madison, and enrollments dropping off with distance from Madison except for a high concentration in the populous industrial region of southeastern Wisconsin.

UWEX-Engineering's attraction in the national and international continuing education market can be ascribed largely to our institutes and short courses, due to their unique and highly specialized nature and the broad spectrum of interests which they serve. UWEX-Engineering's influence within the state is somewhat different and extends chiefly to five manufacturing areas: 1) nonelectrical machinery, 2) food and related products, 3) transportation equipment, 4) paper and related products, 5) electrical machinery, in addition to smaller industries such as chemicals, clothing and furniture.

Our faculty is continually alert for problem areas that persist or to new concerns that arise which involve science, technology, the professional, the state and the public. The department maintains the flexibility needed to respond to these problems and issues when they are perceived. And to whatever degree is possible we try to detect and be alert to clues that will suggest tomorrow's problems...to forsee them in advance of critical need.

As an example, one area of concern in which UWEX-Engineering has been active is that of energy conservation/reduction/management, a very serious concern at state and federal levels and for industry and the public. Last year, a new unit called the Energy Technology Center was formed within the department and several of the faculty assigned to guide its programs and projects. As well as a substantial number of our regular programs directed at specific energy problems, energy topics were included in various other programs. Several are listed below:

SOLAR ENERGY THERMAL PROCESSES
    ENERGY MANAGEMENT FOR MANUFACTURING PLANTS
INDUSTRIAL PLANT BOILERS--MEASURING AND IMPROVING EFFICIENCY
    CONDUCTING ENERGY USE SURVEYS
BUILDING ENERGY STANDARDS AND CODES
    ENERGY ASPECTS IN RESIDENTIAL DESIGN AND CONSTRUCTION
COMPUTER PROGRAMS FOR EVALUATING BUILDINGS AND SYSTEMS PERFORMANCE (in energy use)
    ENERGY--COMMERCIAL BUILDINGS
ENERGY CONSERVATION IN WASTEWATER TREATMENT
    ENERGY FROM WOOD AND BARK RESIDUES
HEAT PUMP APPLICATIONS

One of the Energy Technology Center's special projects was to develop a program entitled "Boiler Plant--Combustion Efficiency Improvement." The two-day program is intended primarily for operators and personnel of gas or oil-fired boiler plants in Wisconsin and was designed to be presented at a wide variety of locations around the state. A total of 30 sessions were planned for the first year.

The Energy Technology Center staff began another crucial phase of programming with the planning and development of the nation's first formal Energy Management Certificate Program, since renamed the Energy Management Diploma Program. The program includes both the Energy Management Diploma and the Advanced Energy Management Diploma; the first is a general course of study designed to serve the needs of all practicing energy managers and engineers. The second is aimed at specialized practices such as plant engineering, building design, research-development-demonstration, and technical management.

In addition to the area of energy, special emphases have also been made in such areas as Building, Construction and Housing; the problems and needs relating to public welfare, public works and planning on the community, municipal, urban and regional levels; safety, accident prevention, and health; waste management and materials recycling; legal and liability issues; and environmental impacts.

Needs assessment comes in many forms. In a review of institutes and short courses conducted by this department, the following were categorized in order of importance as sources of course ideas:

Source	Rank of Importance
Inquiries--The most important and efficient barometer of continuing education needs is the interest voiced by professionals in the field.	1
Evaluation Sheets--Attendees at continuing education programs often have good suggestions as to the content of other programs. Valuable needs assessment tools in the immediate post-course evaluation are questions such as, "What other subjects would you want covered in a similar program, and "Can you recommend competent speakers for this or other programs?" Such questions throw light on problem areas in industry and business, and at UWEX-Engineering they have engendered programs in product safety, energy and environmental engineering. (REFERENCE 1)	2
Professional Journals--The task of the professional journal is to keep members of the profession informed and up to date. To the degree that a large part of this effort is directed toward trends and changes in the profession, these journals are doing part of the continuing education administrators needs analysis job for him..	3
Advisory Committees	-
Colleagues--Discussion with colleagues in engineering continuing education are an important idea source. In addition, many of UWEX-Engineering faculty are professionally active in engineering and consulting firms and can therefore view clientele needs from the perspective of the clientele among and with whom they work.	-
Trade Magazines	-
News and Business Press	-
Surveys--Properly designed, surveys can be an excellent source of information and an inexpensive access to large number of opinions.	-
Professional Societies--Membership not only entitles the faculty member to a society journal, but also provides contact with other members of the societies, often on a monthly basis. (REFERENCE 1)	-

We bear always in mind that educational needs assessment is still in its infancy and often produces questionable results. For accurate management decisions, the full range of needs assessment techniques should be applied and, most important, interpreted with experienced judgement. In one UWEX-Engineering questionnaire response, for example, 2,494 responses indicated interest in pursuing a Master of Science degree. It was the opinion of seasoned faculty that only about 10% of these expressing interest would actually take a course, and even fewer would follow through the entire program.

3. Promotion

UWEX-Engineering's primary means of promoting program attendance is to print and mail an announcement of a program directly to prospective students, ideally to reach them six weeks prior to the starting date of the program. The announcement includes an outline of the program, enrollment information, and a registration form. These announcements have increased over the years to the present level of 21,000 brochures for the average institute and 25,000 brochures for each short course. Average attendance during this time has been about 55 per institute and 25 per short course, for a return of 2.6 per 1,000 brochures for each institute and 1.0 per 1,000 for each short course. The apparently low return should not be taken as a negative sign. A study conducted in 1970 indicated that 90% of those attending a program had learned of it from the brochure, either by receiving it in the mail or from an acquaintance who had received it in the mail.

The course announcements, brochures, and the UWEX-Engineering annual course catalog are sent according to a mailing list which we have built to 65,000 names and which continues to grow by 1,000 names yearly. The names come from program attendance rosters and society surveys, including as well those who have expressed interest through direct inquiries. The list is kept on computer tape, the names coded under one or more of 58 interest categories.

The UWEX-Engineering course catalog is mailed once each year in late summer to everyone on the mailing list, giving the title, date and fee for all institutes and short courses planned in the coming year. Included in the catalog is a tear-out form listing all the programs by number. Persons receiving the catalog are instructed to circle the numbers of programs for which they are interested in receiving announcements. Announcements sent as a result of this request usually precede the bulk mailing by at least two weeks.

In approximately half the program mailings, outside lists, primarily those of professional societies, are also used. This is partly to cover new interest categories where our own lists have only a few names, and partly to reach new people or to expand geographic coverage.

UWEX-Engineering does not pay for magazine or newspaper advertisements but does make use of these forums in advertising courses. News releases and small articles on upcoming programs are sent routinely to appropriate trade and professional journals and the editors are frequently willing to donate space as an information service to their readers. Many trade magazines have a section devoted to listing coming events. One problem is that the lead time required by magazines--three to five months--makes it difficult to get announcements published far enough in advance of the course and difficult to measure their effectiveness. Seven years ago we assigned to one of our secretaries the responsibility of sending the appropriate information to selectively chosen magazines on a regular basis. The number of inquiries that we receive as a result of this effort has been significant enough to convince us that it is worth continuing.

Posters for placement in private industry are used only occasionally, not for institutes and short courses, but only for SEEN courses and some evening courses given by our Milwaukee campus. In addition, faculty generally try to promote and advertise their programs wherever the chance arises. When they go to professional society meetings, for example, they frequently take along a bundle of brochures to scatter on tables and pass around.

4. Costs

UWEX-Engineering's most recent assessment of operational costs for each of the programming formats is as follows:

	Average	Cost/ST CEU*
Institutes	$130/two days	$108
Short Courses	$350/week	$ 87
Corr. Courses	$ 90/18 lessons	$ 20
Electrowriter	$ 75/12 sessions	$ 35
Video Cassette	$170/24 lessons	--
Evening Classes	$ 50/12 sessions	$ 23

These figures cover all departmental costs excluding building rental and indirect costs such as payroll and chancellor office costs.

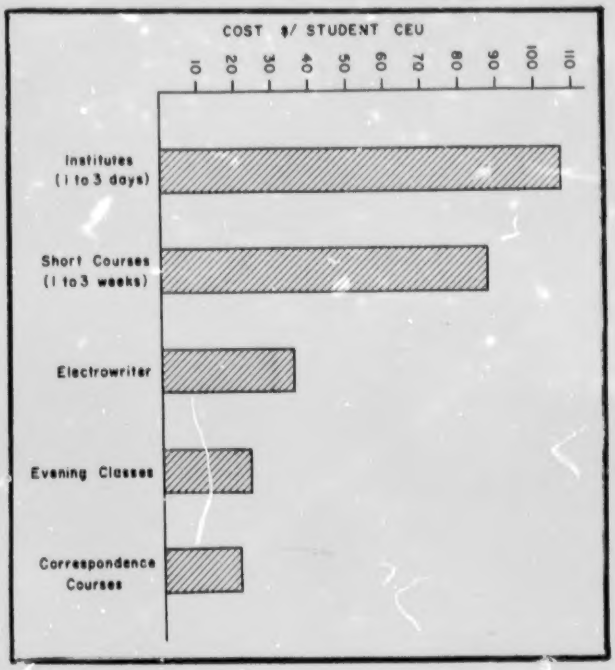
For Institutes and Short Courses, the cost might break down as follows:

Program Director and Support Costs	$3,000
Teaching Faculty	$1,300
Promotion	$1,000
Meals (breaks, etc.)	$1,000
Misc. (books, notes, projectors)	$1,200
	$7,500

Video cassette development is very costly when they are designed to be sold to the public. In our most recently developed course, we spent approximately $100,000 to produce the tapes and study guide. The course included 24 lessons, with 24 ½-hour cassettes.

The Electrowriter system costs $30,000/year to serve 25 locations over a network of 2,500 circuit miles.

Development costs for correspondence courses range from $3,000-$10,000 depending on how well the text is designed for independent study. Maintenance costs, for grading and processing, amount to about $5.00 per student lesson.



*Continuing Education Unit (CEU) is 10 hours of learning under qualified organizational leadership

5. FORMAT

1) Institutes, short courses and workshops. Institutes are the most popular form of continuing education generally, two- or three-day intensive programs which bring together experts from government, industry and academia to present state-of-the-art information on a very specific engineering problem or field, for the benefit of both technical and nontechnical people. The institute's chief advantage is that a program with the most current information can be put together in a relatively short time.

Short courses operate on the same basic idea as institutes but with longer duration--from four or five days to three weeks--and a smaller student body, averaging 30 or less. Thus, although content is generally more theoretical and covers a broader field, there is more in-depth discussion and personal contact, and sometimes study outside of class. As a result, short courses are more effective than institutes. Students are more likely to actually learn new concepts in addition to getting a general overview.

Short courses often focus on practical applications to industry problems, sometimes expanding on theoretical knowledge for practicing professionals. Often they are very similar to undergraduate and graduate courses being offered on campus. Many programs try to relate to current problems of physical, economic, and social concern, both locally and nationally.

Workshops frequently involve participants in working sessions on special projects or case studies.

Institutes, workshops, and short courses given by UWEX-Engineering during the last two fiscal years show the following figures:

Institutes, Workshops (1-3 days)

	1976-77	1977-78
Number Offered	211	214
Number Conducted	200	204
Cancelled (low enrollment)	11(5%)	10(5%)
Total Enrollment	12,075	11,058
Avg. Enrollment/Course	60	54
Total Student CEU's	14,490	13,270
Avg. CEU's/Course	72	65
New Courses (or over 50% NEW Content)	155	156

Short Courses (1-3 weeks)

	1976-77	1977-78
Number Offered	79	87
Number Conducted	72	82
Cancelled	7(9%)	5(6%)
Total Enrollment	2,065	2,462
Avg. Enrollment/Course	29	30
Total Student CEU's	8,260	9,848
Avg. CEU's/Course	115	120
New Courses (or over 50% NEW Content)	32	35

COMBINED (Institutes and Short Courses)

Programs Conducted	272	286
Total Enrollments	14,140	13,520
Total CEU's	22,750	23,118

2) Evening classes vary in duration and in the number of meetings per week, depending on subject matter. Their unique purpose is to fulfill an urban mission of serving local engineering and local industry with specifically designed state-of-the-art programs. Some evening courses are designed to refresh and update the knowledge of engineers who have been years out of school, and some are designed to teach skills in management, sales and communications.

	1976-77	1977-78
Number Offered	54	55
Number Conducted	42	46
Cancelled (low enrollment)	12(22%)	9(16.4%)
Total Enrollment	776	876
Avg. Enrollment/Course	18.5	19.0
Total CEU's	2,359	2,420.9
New Courses	25	17

3) Correspondence courses offer learning opportunities for people whose access to other modes of instruction is limited by a variety of conditions over which they have no control. The correspondence course is primarily a written course of instruction involving a continuing exchange between instructor and student. They are usually based on one or more textbooks with a study guide to clarify content and set assignments, and can involve slides, audio or videotapes, and educational or cable TV.

	1976-77	1977-78
Number Offered	58	54
Number Conducted	58	54
Total Enrollment	1,775	2,050(Est)
Avg. Enr/Course	30	38
Total Student CEU's	7,050	6,200
Avg. CEU's/Course	120	115
Lessons Graded	11,719	10,339

4) Electronic Media Programming in Engineering (EMPE) is the name of a general category which encompasses all electronic media instructional efforts of the department. This includes design, production, coordination, scheduling, monitoring, and evaluating instruction delivered through SEEN (Statewide Extension Education Network), ETN (Educational Telephone Network), VCC (Video Cassette Courses), and Cable TV.

a. ETN operates by two-way audio communication over leased commercial telephone lines between an instructor at a central location and students at any number of locations around the state. Unaided, the system is not very useful for engineering due to lack of communication.

b. SEEN adds the visual element. SEEN differs from ETN in that it includes one-way use of an electrowriter system. Each classroom has an overhead projector with a writing instrument controlled electronically by the writing instrument in the hands of the instructor, who is thus able to communicate with graphs. diagrams, and equations.

c. UWEX-Engineering broadcasts engineering programs statewide over regular cable television networks, but because of the small audience for such programs, they can only be broadcast at odd times of the day such as early morning--not always convenient for working engineers.

d. Video cassettes put the student on an almost completely independent and flexible time table. Without a pacing mechanism such as television broadcast schedules, they require more self-motivation, but there are compensatory rewards in being able to set one's own pace.

Two of these electronic systems have proven outstandingly effective at UWEX-Engineering and deserve further emphasis: SEEN and VCC. SEEN serves on-campus undergraduate and graduate students, off-campus continuing education students in credit courses, and non-credit continuing education students. SEEN has the advantage that in many cases the alternative would be no course at all. SEEN brings continuing education to the engineer in or near his home community, eliminating or reducing traveling expenses and time away from the job, making education easier for both student and teacher. In one instance, a UWEX-Engineering instructor taught a class from his hotel room in Connecticut while a second instructor assisted from San Francisco, both of them conversing with groups of Wisconsin students at locations ranging from Lake Superior to the Illinois border. SEEN terminals can also be set up in the factory or office, or wherever else there is sufficient demand, availing employees of training on the job.

VCC courses can be used to serve students in a number of ways. On-campus it can be used in place of live lecture or in place of a SEEN transmission and can be repeated several times to accommodate students. It can also be used by firms or agencies or on-site continuing education. It has the advantage of a one-time production that can be used over and over again, so that in the long run it provides high quality education at a much lower price than might appear from the costs of original production.

	SEEN/ETN		etvn/VCC*		Total EMPE	
	1976-77	1977-78	1976-77	1977-78	1976-77	1977-78
Number Offered	22	25	13	209	35	234
Number Conducted	16	21	13	209	29	230
Cancelled	6(28%)	4(16%)	0	---	6	4
Total Enrollment	442	489	83	1,055	525	1,544
Avg. Enrollment/prog	27.6	23.3	6.4	5	18	7
Total Student CEU's	1,469	1,646	754	1,172	2,223	1,018
Avg. CEU's/prog	92	78	58	5	77	13
New Courses	5	12	0	0	5	12

*Includes Digital Technology which was separately reported in the 1976-77 report.

Does not include students participating under non-UWEX service arrangements, i.e. only those graded and examined by UWEX are included.

Approximately 650 non-UWEX-serviced participants were studying our VCC courses in '77-'78 at 29 locations, including three campuses of the UW-Center System.

The composite picture of enrollment for the four primary programming formats, then, is as follows:

		1975-76	1976-77	1977-78
		#	#	#
A.	Institutes & Short Courses	10,912	14,140	13,520
B.	Evening Courses	654	776	876
C.	Independent Study	1,909	1,750	2,050
D.	EMPE (Electromedia)	574	525	1,544
		14,049	17,191	17,990
	*Gratis enrollments or partial fee	1,200	1,350	1,280
	TOTALS ...	15,249	18,541	19,270

*Participants such as program speakers, UW faculty, specialists from different campuses, graduate students, faculty of other universities, individuals from state and federal agencies, magazine editors, etc.

Also deserving of further mention is:

5) The Professional Development Degree is a special kind of continuing education format in which other continuing education formats can be combined with independent study and testing in a combination determined by each individual candidate. The objective is a post-baccalaureate degree. The method is to allow each professional to design, with the aid of a faculty advisor, a sequence of courses structured toward the goal of increasing his capability for added technical and managerial responsibilities. The program must include technical updating courses, technical advancement courses, professional elective courses, outside interest electives and an independent study project, but the mixture and choice of courses is up to the individual. The degree's "professional development" value arises from its optimum reinforcement between education and on-the-job experience. The credits must be earned in no less than three years and no more than seven, and are pursued in the student's spare time while he continues work at his professional career. In less than three years there would not be adequate blending of education and experience, and the professional development value would be diluted. In more than seven years, the blending would also be weak, and the degree would start to go stale with obsolete information. The program is open to candidates holding a BS in engineering or a BS in some other field plus registration as a professional engineer.

Gross enrollment statistics have already been provided in section 5, "Format," along with some discussion of geographic dispersion in section 2, "Needs Analysis;" but there are numerous other useful criteria according to which continuing education participants can be characterized, and a number of these were investigated in a 1977 survey of 90 UWEX-Engineering programs.

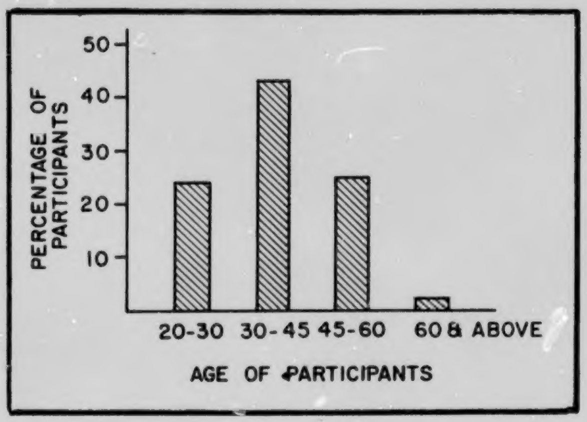
Most attendees, for example, had had prior experience with continuing professional education, 53% having been involved in more than one in-house program and 69% having attended more than one conference, institute, non-credit class, or other program outside the company.

Much more attendance was found to originate in large companies than in small ones, 61% coming from organizations of more than 100 employees, and more than half of that number coming from companies of over 1,000 employees. Still, small and growing companies did make an impressive contribution to course attendance considering their more limited resources. Fully 12% of the student body worked for companies employing 10 persons or fewer. Some other facts:

All fees were paid by the participant's employer in 81% of the cases, and most or a substantial part was paid in most of the rest. Only 3% said that expenses came totally from their own pockets.

A set of 2,400 questionnaires sent by UWEX-Engineering to Wisconsin residents showed that a large percentage (40%) of the state's engineers are interested in management, and that about 25% of them are no longer interested in their original field of study.

The age distribution of participants was broken down as in the following graph:



Several influences of enrollment type on program planning can be cited. Since the curve of attendance vs age reaches a maximum in the prime working years of professionals, programs tend to be planned for shorter periods such as two or three days so that people will be able to afford the time. For courses that serve industry or profession that is seasonal in nature, scheduling should be planned accordingly; construction related programs are concentrated more in the winter than in summer, for example.

7. Staffing

UWEX-Engineering considers it very important for program directors to understand both education and their area of specialty, and how the two are related within the changing industrial, business and economic environment. The faculty must be able to recognize needs and to design educational programs to serve them.

Our Extension Engineering faculty numbers 42 at present. Many of them have earned the Ph.D. degree, most are registered engineers or architects, most have at least 5 years professional experience before joining our staff. They have practiced in industry and consulting organizations, built reputations as private contractors and businessmen, or worked for municipal, state or federal government.

When faculty have selected a topic for a course, effort then shifts to finding outstanding spokesmen to serve as instructors. These may well be drawn from all walks, including research and development scientists, engineers, salesmen, technicians, board chairmen, or commissioners--experts who have become successful in their professions and come to Wisconsin to spread that success around.

A recent institute on Passive Solar Design and Construction, for example, counted among its instructors solar energy scientists and administrators from Los Alamos Scientific Laboratory and the federal Department of Energy. Among the speakers at another institute, Product Liability for Claims Personnel, were International Harvester's senior counsel for product litigation, a claims specialist from Sentry Insurance, and experts from the Alliance of American Insurers, Hawkeye-Security Insurance Company, Scottish and York International Group, Rockwell International, and the U.S. Department of Agriculture. Over 1000 ad hoc faculty lecture in our programs each year.

We have assembled in extension a faculty among which are skills and experience readily available for addressing most of the range of technology. Through its talent, diligence, and awareness of problems and concerns, this faculty has continued to produce an exceptionally comprehensive program operation. Our faculty is widely recognized for its performance in the job of organizing and conducting superior programs. Its reputation is outstanding in national engineering extension service.

8. Other Continuing Education

UWEX-Engineering recently undertook a study, funded by the NSF, of continuing education among the nation's engineers and scientists. The results showed the following figures:

Total Noncredit Activities
Reported by Institution Type

Institution Type	No of Activ	No of Activ	No of Enr	CEU's
University	92	3,514	114,688	338,123
Professional/ Technical Organization	55	1,295	71,904	107,915
Both	147	4,809	186,592	446,098

In the last fiscal year, UWEX-Engineering served 18,000 people with its educational programs. As noted in the introduction to this report, 18,000 represents 15% of all enrollees in programs sponsored by those institutions that responded.

9. Evaluation

Student learning at UWEX-Engineering is not evaluated in institutes. For short courses, evening classes, and SEEN courses, student evaluation is not mandatory but is available at the discretion of the program director. Upon occasion, such as in the Professional Development Degree Program, student learning is evaluated at the specific request of the student.

Programs, however, are routinely evaluated. Participants get a one-page evaluation form in the material that they receive when they register. This evaluation helps establish for the director how successful the program is and allows participants to contribute ideas for making the program better in the future. One UWEX-Engineering study tried to determine what differences course evaluations showed between the types of programs from different years and found that no general conclusion could be drawn. A five-point rating scale was used to rate program content, presentation, objectives, facilities and "overall," as shown in Table 1. The study analyzed 1,162 evaluation forms from the years 1974 and 1975 and found no significant differences in any of the groupings. In fact, with the exception of "Institutes vs Short Courses," the average ratings seldom differed by more than 0.10.

	Evaluation Categories				
Program Groupings	Program Content	Program Presentation	Objectives	Facilities	Overall Rating
Institutes vs	4.30	4.06	4.10	4.02	4.09
Short Courses	4.20	4.35	4.28	4.07	4.62
Specific subject programs	4.09	4.28	4.11	4.02	4.27
vs. general subject	4.08	4.27	4.03	4.12	4.18
Construction oriented	4.08	4.23	4.02	4.12	4.22
programs vs. manufacturing oriented programs	4.09	4.35	4.11	4.05	4.20
1974 programs vs.	4.05	4.29	4.09	3.97	4.13
1975 programs	4.09	4.27	4.06	4.00	4.21

On occasion, UWEX-Engineering program directors conduct a post-evaluation of a program. An example is a survey involving students enrolled over three consecutive years in an annual two-day "Working Drawing" institute. Responses were received from 146 persons, 76 of which responded "yes" to the question, "Has your firm saved money as a result of your introducing ideas that were presented at the institute you attended?" Forty-six of the 76 estimated savings totaling $451,000. The other 30 responding "yes" were unable to make a reasonable estimate but felt that attendance did result in monetary savings by their firm.

Instructors are judged in part according to responses on the program evaluation forms, and partly according to the program director's assessment: does the instructor provide content rather than polished but empty presentation? Is the content well presented? Etc.

In one UWEX-Engineering study of student evaluations, speakers were divided for convenience into three categories:

1) M/S/P--Manufacturers of products, Suppliers who deliver various products, or Practitioners. Included were corporate representatives and officers, industry representatives, public utility representatives, and so on.

2) U.P.--University Professors and Extension Personnel. Individuals associated with an educational institution.

3) G/P--Government representatives of local, state, or federal agencies or offices. Private research organizations and private consultants.

Speakers were then rated as follows for insitutes and short courses.

Institutes

Average Rating	Speaker Categories	U.P N = 71	G/P N = 84	M/S/P N = 115
	Content	4.05	3.97	4.03
$\bar{X}$	Presentation	4.06	3.94	3.97

Short Courses

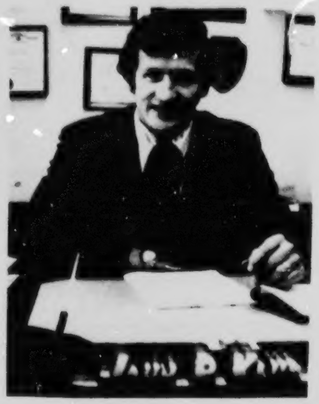
Average Rating	Speaker Categories	U.P N = 71	G/P N = 84	M/S/P N = 115
	Content	4.30	4.37	3.90
$\bar{X}$	Presentation	4.29	4.32	3.73

We will not further analyze these particular results because our purpose here is not to detail the results of our evaluation, but rather to describe how UWEX-Engineering goes about its evaluative procedures and why. Studies of this type assist our organization in several important ways. First, the results themselves may be analyzed, content and presentation can be compared in all categories. Second, it assists in refining our knowledge of evaluative procedures and developing ways of improving them. It brings forth questions that must be brought forth: Does the evaluation instrument measure what we want to know? How valid are the categories to which we have assigned the speakers? Is the present form of the evaluation discriminative enough to measure what is useful?

Evaluation is useful not only in improving continuing education operations but as a means of assessing and improving the evaluative mechanisms themselves. Like needs analysis, program evaluation is as yet an uncertain art; it must be used as a tool by experienced administrators and not as a programming guide definitive in and of itself.

10. Indicators

Success in our programs is indicated principally by five variables. For accounting purposes, student CEU's are effective. For judging of program quality, student evaluations and longitudinal studies are important. The best indicators of all, however, are recurring attendance at ongoing programs and the analyses of experienced program directors. Secondary indicators, though hard to quantify, are as numerous as the ingenuity of the program director can make them. The program director's intuition is an important secondary indicator, as are written comments from program participants and the kinds of questions they ask during a question and answer period. Also important is coverage in magazines and newspapers. If several articles appear on a program, it probably means the program has touched an important need or interest in the profession.



JOHN P. KLUS

John P. Klus...Chairman, Department of Engineering, University of Wisconsin--Extension since 1967. Professor of Civil Engineering. Degrees from Michigan Technological University and Ph.D., University of Wisconsin. Fulbright scholar 1966-67 for teaching and research in Finland. Chairman current UNESCO International Working Group on Continuing Education of Engineers. Member ASCE, ASEE, APWA, AAAS, Wi Acad of Sciences, Arts and Letters, NSPE and WSPE. National and international lecturer. Author of 40 technical and continuing education papers and publications; most recently: co-author "Engineers Involved in Continuing Education--A Survey Analysis" (An ASEE Monograph, 1975); editorial director of "Continuing Education for Engineers--A University Program" (A UNESCO case study, 1974).

PART-TIME POST GRADUATE EVENING PROGRAMME AT HBTI KANPUR

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Summary

The paper describes the experiences of running part-time post-graduate evening programme evolved over the past five years at HBTI, Kanpur, and highlights some of the salient features of the programme which besides offering an opportunity to a wide cross section of engineers to acquire higher qualification provides an effective means to bridge the gap between the academic and professional worlds through mutual interaction between the two cultures. The programme having annual examination scheme is of three years duration as against two years for a regular post-graduate programme. The teacher - student contact time is 12 hours a week arranged on four evenings including holidays. The faculty members offering the courses carry 2 to 4 hours of extra teaching load per week in addition to the teaching schedule for regular classes in day. The entire expenditure on the courses including administrative, laboratory and institutional expenses and a nominal payment to faculty members is met from the fee income.

Background

Engineering institutions in India send out nearly 18,000 engineering graduates every year. Kanpur among the first seven cities of the country has one of the biggest industrial complexes. The Harcourt Butler Technological Institute, Kanpur was established in 1921 to meet the need of technologists in the region and also to provide in the state a base for industrial research and consultation. To-day the Institute provides formal education in nine disciplines of engineering and technology at undergraduate and postgraduate level with a total enrolment of about 800 students.

Kanpur has about 5000 engineers serving a number of defence units, cotton and jute mills, aircraft industry, electricity corporations, engineering, chemical and electronics industries, government departments and corporations and teaching institutions. Some of these engineers, a large majority of whom had only bachelors degree, wanted facilities for further studies while being on the job. As a result HBTI started part-time post-graduate evening courses in chemical, civil, electrical and mechanical engineering in the year 1973 with a total intake of 50 students. The courses having annual examination scheme are of three years duration as against two years for regular post graduate programme.

Need and Motivation

The main factors responsible for the recognition of the need are

1. Realization on the part of engineers of the benefits of application of advanced techniques and technology to the engineering activities, they are engaged in.

2. Adoption of sophisticated technology by leading industries, government organisations and other enterprises.

3. Better future prospects for engineers having higher qualification.

4. Increase in the design, research and development activities in major organisations.

5. Desire to keep abreast of the latest advancements in engineering and technology.

The large strength of local engineering population, availability of suitable faculty and facilities in the institute and its central location provided enough confidence in the success of the programme without undertaking a formal survey. One of the motivations for the programme for junior level professionals is said to be a higher university degree. The engineers who are qualified by written examination of the Institution of

Engineers (India) as private candidates appear to have a special desire for it. Engineers at top and middle level positions are interested in learning about new techniques and technology so as to involve this knowledge in decision making process and also to appreciate the viewpoints of young engineers already equipped with newer technology. Enhancement of pay on acquiring masters degree has also been a cause of motivation to about 20 percent of the students. In some of the organisations promotional opportunities are rather small. The engineers of these organisations want to improve chances of their employment elsewhere by acquiring higher qualification. The engineers in government and defence organisations and in some of the private undertakings are transferable after three to four years. Some of them want to take advantage of the evening course facility at HBTI during their tenure at Kanpur knowing that this facility is available only at a very few places in the country.

Enrolment

Admissions are made through advertisements in leading news papers. The number of applicants seeking admission have been on an average double the number of seats available. Table 1 gives the enrolment information for the disciplines of Civil, Electrical and Mechanical engineering for a period of six years from 1973 to 1978. Civil engineering has admitted equal number of BE and AMIE degree holders whereas admissions in Electrical engineering and Industrial Systems engineering have been predominantly to BE degree holders.

Table 1: Admission details for period 1973 to 1978.

Table 1 continued

Discipline	Total Admn.	Entrance qualification		Drop-outs till 1977	Defence Orgns.	Govt. Deptt	Teaching Insts.	State Corpns	Railway	Private Orgns
		B.E./B.Tech. B.Sc.(Engg.)	AMIE							
1	2	3	4	5	6	7	8	9	10	11
Civil Eng.	48	24	24	9	12	9	8	9	10	-
Elect.Eng.	50	39	11	8	8	4	12	17	3	6
Mech. Eng. (Design)	78	46	32	20	27	10	12	22	-	7
Industrial Systems Eng. (from 1976)	33	25	8	3	13	2	2	13	-	3
TOTAL	209	134	75	40	60	25	34	61	13	16

Civil engineering has drawn more or less equal number of candidates from various kinds of organisations but electrical engineering course has found more favour with state corporations and teaching institutions. In mechanical engineering the maximum rush has been from defence organisations followed by state corporations. The job responsibilities of the candidates span a very wide range of engineering activity. Officers at the juniormost level and one heading the same department are on rolls of the same class.

Table 2 shows age wise breakup of admissions. Maximum number of candidates admitted are in the age group of 26 to 30 years followed by the group 31 to 35 years. These two groups together account for two third of total admissions so far.

Table 2: Agewise breakup of admissions for period 1973 to 1978.

Discipline	Under 25	26- 30	31- 35	36- 40	41- 45	46- 50	51- 55
Civil Eng.	4	12	13	14	4	-	1
Elect.Eng.	7	24	15	4	-	-	-
Mech. Engg. (Drawing)	11	34	21	10	1	-	1
Industrial Systems Engg. (from 1978)	4	8	11	8	1	1	-
TOTAL	26	78	60	36	6	1	2

Costs

The courses are self supporting and financed by fee income. A student pays the following fees

A Annual fees

1.	Tution fee	Rs. 800
2.	Institute fee	Rs. 55
3.	Examination fee	Rs. 125

B Fees paid at the time of admission

4.	Caution money (refundable)	Rs. 100
5.	Admission and other misc. fees	Rs. 40

The tution fee for part-time students is double the fee for regular post-graduate students. The fees at item (2) and (5) are credited to the institute account and cover the expenditure on laboratory raw material, library services, information to students etc. The examination fee is remitted to the university towards expenditure incurred in conducting examinations. All other expenses on the courses are met from tution fee as shown in Table 3. The average cost per student study hour is approximately Rs.4. The costs on postage, phone calls etc. are borne by the institute and the cost on advertisement, brochure etc. is recovered by pricing the admission forms, The accounts for each course are maintained separately.

Table 3: Approximate cost breakup per student per annum.

1.	Course coordinator @ 1½%	Rs. 12
2.	Administrative expenses @ 7½%	Rs. 60
3.	Supporting staff for assistance in laboratory, class rooms, office work etc. @ 5%	Rs. 40
4.	Overhead expenses for utilities, maintenance etc. @ 3½%	Rs. 28
5.	Materials and contingency @ 2½%	Rs. 20
6.	Instructors @ 80%	Rs.640
	TOTAL	Rs.800

Course structure and student views

The regular M.Tech. courses build firm foundation of basic knowledge necessary to the acquisition of applied knowledge in a specialized discipline. This generally leaves a gap between the level of acquired knowledge and the knowledge required for successful contribution to the frontiers of engineering practice. Recently there have been some efforts in this country to reduce this gap by starting what are called the industry oriented post-graduate courses. Such courses are run in collaboration with a chosen industry specialising in a particular range of product. Training a student in such mixed background provides him some on-the- job experience and skill to make him suitable for immediately assuming professional responsibilities in industries of allied nature. The students of part-time courses have already gained experience in the field and possess practical knowledge which in some cases may exceed similar knowledge of the instructor. Most of these candidates have preference for so called applied knowledge which they think can be directly used for the job in hand.

The major considerations for part-time course curriculum are:

1. Interest of the prospective candidates. This is related to his present employment needs, his desire to learn about advanced techniques and new knowledge in his area of interest and enhanced chances of his employment elsewhere.

2. Usefulness of the education to the sponsoring organisations.

3. The previous educational background of the prospective candidates. The curriculum content for undergraduate courses has undergone rapid changes making significant difference in the level of education over a period of a decade. Because candidates of all ages (and hence of all levels of education) apply, the curriculum design for part-time courses has constraints as to the inclusion of very advanced level mathematics oriented courses, particularly so because of the admission of AMIE candidates who have had mostly self study and have missed the advantage of class room learning and guidance from institute faculty.

Table 4 lists the courses presently offered in various disciplines. There are ten to twelve theory courses in the first two years of the programme followed by seminar and thesis in the third year. Laboratory courses are also an essential part of the programme. Total contact time is 10 to 12 hours a week and the classes are arranged on two to three evenings after 6 PM on week days and on sundays. The faculty members offering the courses carry extra teaching load up to 4 hours a week in addition to the teaching schedule for regular classes in day.

A survey was conducted to obtain students opinion about the programme.

Table 4: Curriculum contents for the part-time courses, Seminar and thesis are included in all courses.

Civil Eng.	Electrical Eng.
Mathematics I,II	Mathematics I,II
Numerical methods	Numerical methods
Theory of elasticity	Dynamics of electrical machines and circuits
Advanced solid mechanics	Electronic devices and circuits
Theoretical soil mechanics	Modern control theory
Advanced soil mechanics	Network analysis
Foundation Eng.	Power electronics and drives
Experimental stress analysis	
Electives: any two	Electives: any two
Soil Dynamics	Power system operations and Control--computer methods
Pavement design	
Theory of seepage	
Clay minerology	Non linear control systems
Applied Geology	
Design of earth structures	Power system analysis
Pile foundations	Power system stability
Applied soil mechanics	Power system protection
Shear strength of soils	Stochastic control theory
Subsurface exploration and testing	Optimal control theory
Tunnel engineering	
Soil Chemistry	Industrial control of electric motors
Rural water supply & sanitation	Bio-instrumentation
Material science	
Expansive soils	
Hydrology	

contd.....

Table 4 continued

Mechanical Eng. (Design)	Industrial System Eng.
Advanced mathematics	Advance mathematics
Fluid mechanics	Computational methods
Mechanics of solids	Statistical methods in Eng.
Material science	Systems engineering
Design	Operations research
Numerical analysis	Design of equipment and facilities
Elasticity & plasticity	
Experimental stress analysis	Management of industrial systems I, II
Heat transfer	Design of production systems
Production processes	Network methods
Process equipment design	Electives: any two:
	Industrial instrumentation and control
	Work study
	Industrial environmental control
	Automation
	Maintenance eng.
	Production processes
	Management information systems

Out of about 150 questionaires sent 40 were returned. 31 students found the present contact hours adequate. The time spent by them on home study is shown in Table 5; 24 of them found the availability of time difficult, 8 very difficult and 8 had no difficulty. In reply to the question whether they had any problem because of the difference in level of their undergraduate education and the present level, 6 of them expressed difficulty in understanding lectures, 23 felt the gap in levels but not much difficulty and 11 had no problem in following the lectures. Only 9 of them preferred extra classes to cover the deficiency (because of non-availability of time), 12 preferred extra assignments in deficient subjects and the rest were for self study under faculty guidance. On the question that many undergraduate students lay emphasis on passing the examination rather than on learning the subject, 90 percent of them expressed stress on learning the subject and only about 20 percent were for studies to be examination oriented. For designing the curriculum students gave almost equal preference to advance level courses, courses useful in their present career and the courses likely to be useful in future. Low preference was given to courses bearing relation to their educational background, in comparison to above considerations. It was also found that in general, candidates having university degree gave high priority to advance level courses where as the AMIE candidates preferred courses helpful in their present and likely future career. Many of the students wanted increased emphasis on computer programming and applications. They were also of the view that equal emphasis should be given to explanation of theoretical concepts and solution of examples in the class. As regards the choice of subjects for their theses and seminars equal preference was expressed for problems concerning their present organisations, problems of current industrial and national interest and problems on any scientific investigation generating useful information and knowledge in the area of their interest.

Table 5: Time spent by students on home study per week.

Less than 5 hours	8
6 to 10 hours	15
11 to 15 hours	7
16 to 20 hours	5
21 to 25 hours	3
26 to 30 hours	1

Evaluation

Student performance is evaluated through annual examination at the end of each session and through tests, assignments and other course work during the session. The sessional marks are awarded by the instructor. 100 marks are allotted to each theory and practical course examination and 500 marks for the thesis. 50 marks are allotted for sessional work in each course. The seminar carries 100 marks. In the survey described above, the students were asked whether the examination and sessional awards received by them truely reflected their understanding and performance in the subject. 70 percent of them were satisfied with the examination marks and 62 percent with the sessional awards.

Evaluation of instructor is not a regular practice. Since all instructors are regular faculty members of the institute evaluation is relevant only to the extent of providing them feedback of the students opinion. Change of instructor is virtually ruled out. No formal opinion poll is made but informal talks of students with the course coordinator do provide information about the performance of instructors. It is the delicate responsibility of the course coordinator to pass on this information to the concerning faculty member in a manner so as to avoid ill feelings and irrelevant criticism. Two important aspects of class room teaching are the instructors knowledge of the subject and his preparation and presentation of the lecture. Table 6 based on survey shows that 66 percent of the students thought that 80 percent of the instructors had sound knowledge of their subject but only 38 percent of the students felt that 80 percent of the instructors prepared their lectures well.

Table 6: Evaluation of instructors - percentage of student opinion about instructors performance.

	Percent of instructo			
	40	60	80	100
Sound knowledge of the subject	5	13	66	16
Good preparation of lecture	5	32	38	25

Indicator

The real success of the programme cannot possibly be measured by the examination awards of the students. The ultimate objective of any effort of this type should be to see that the product going out is better equipped and knowledgeable to deal with the complex real life problems of engineering practice. 55 percent of students surveyed thought their approach to the work has changed to some extent, 20 percent experienced considerable change and 25 percent indicated no change. 62 percent candidates improved their image and professional recognition in their own organisation. 23 percent of students stated that the knowledge gained by them is already proving useful, 62 percent expected it to be very useful in future and 15 percent thought it to be of limited use.

Education is a continuous process and undergoing a programme of continuing education is certainly no end of it. One of the important measures of the success of the programme is the motivation it creates in the students to learn further on their own. 70 percent of the students surveyed expressed their desire to persue further studies for Ph.D. Perhaps by far the most significant indication of the success of the programme is the admission rush. All departments continue to have large number of applications every year compared to the number of seats available. The industrial systems engineering course is particularly having a heavy demand and the admissions have become very competitive.

Some Operational Experiences

One of the major objectives of part-time education is to help the engineers apply developing scientific knowledge and techniques to find better solutions to the problems and to the creation of new effects, devices and structures. The curriculum, therefore, should contain a good portion of advanced level courses with simultaneous emphasis on applications to cater for the demand of local organisations and interest of the experienced professionals. Ten courses are considered adequate for the curriculum. Credit system must replace the annual examination system to enable a student choose convenient number of courses at a time suiting to his time availability. Laboratory work may form part of course work attached to the concerning theory paper. Students should be encouraged to tackle problems of their own organisations through dissertation and seminars. This generates in them a deep interest and enthusiasm for work, a sense of accomplishment and satisfaction of having solved a live problem of current industrial and national interest.

As the courses are financed from the fee income deep involvement of faculty in the programme may be difficult if the number of admissions are low. The faculty can gain considerably from the real life problems posed by the students. They should make best use of it not only for helping students select their theses and seminar topics but also for developing teaching strategies giving practical orientation to the treatment of the subject.

Communication with students is often a problem. Cancellation of classes by faculty at a short notice and absence of students from classes causes resentment and inconvenience to the other group. Lateness of students, so frequent and often for reasons beyond their control, causes irritation to the faculty. Late comming of faculty has the same reaction among the students. A good communication system can eliminate many of the complaints. Most of the students are hard pressed with time because of their official, family and social committments and tend to be out of phase with the work schedule set by the instructor. Tendency to postpone submission dates is high. A liberal attitude on the part of the instructor, howsoever unedesirable, seems to be unavoidable, if the programme has to continue successfully.

The administrative problems with part-time students are little different than those with full time students. They wish to be treated as responsible officers rather than just students. This view point must be considered in selecting administrative staff dealing with them. Non payment of fees in time is a common feature. This of course, should be discouraged but a symphathetic policy must be adopted to accommodate genuine financial difficulties people supporting their families often have in to-days hard times. Library facilities must be arranged to suit the convenience of the students. People above 50 find it difficult to cope with the course requirements and should be admitted only after very careful consideration.

The desire of an individual to keep abreast of the technological advances must be recognised both by the employer and the educational institution if that individual is to remain motivated. The keys to success of the part-time education programme are enthusiastic encouragement by employers availability of proper learning opportunities matched to the professional needs of the practicing engineers at convenient times and places, instruction by experts and competent faculty and sympathetic administration by the institution.

About a dozen institutes in this country provide facilities for part-time post-graduate education but only a couple of them have successful evening programmes. HBTI has taken the lead and hopes to contribute in a big way to the process of continuing education of engineers.

Acknowledgement

The cooperation of students and collegues in prepartion of the paper is acknowledged.

N.L. KACHHARA

Professor N.L. kachhara graduated in Mechanical Engineering from Birla Institute of Technology and Science, Pilani, in 1961 and joined M.B.M. Engineering College, Jodhpur as Lecturer in Mechanical Engineering where he served till August 1969. During this period he obtained his Masters degree in Mechanical Engineering. In August 1969 he moved to Malviya Regional Engineering College, Jaipur as Reader in Mechanical Engineeing from where he procceded to University of Salford, England in October 1971 for his doctoral studies. After completing Ph.D. in 1973 he joined Salford as a Visiting Lecturer. Dr. Kachhara joined Harcourt Butler Technological Institute, Kanpur-2 as Professor and Head of Mechanical Engineering in August 1975.

Professor Kachhara has published widely in his specilized field of Fluid Mechanics. He is organizing and co-ordinating continuing education programme in Mechanical Engineering.

THE ARGENTINA EXPERIENCE

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SUMMARY

This work describe the differents actions undertaken in respect to permanent education for engineer developed in de Argentina Republic. The work has been divided in three parts:

Enviroment : shows by meens of stadistics the country objeet of the described experience.

Institution : mention is made for the main institutions of the Argentina Republic which perform permanent education for engineers.

Proyect : the author proposed a proyect for the systemation of the continuous education of the total engineer career.

1. ENVIROMENT

To be able better visualize the experience hereby described it is convenient to summarye by meens of numeric indicates the country where the experience is been performed

1.1. Social and economic aspects

Surface : 2.791.810 km^2

(Continetal portion only. South Atlantic islands and the Antartica are not includes)

Population : 26.400.000 inhabitans
Density : 9,5 inhabitans/km^2
Doctors : 540 inhabitans/doctor
Telephone lines : 85/ 1000 inhabitans
Cinemas : 38 places/1000 inhabitans
Radios : 420/1000 inhabitans
T V : 185/1000 inhabitans
Paper consumption : 10,5 kg/inhabitans/year
Steel consumption : 170 kg/inhabitans/year
Unemployement : 3,5 %
Nutrition :
  Calories : 3.170 gr/day/inhabitans
  Proteins : 120 gr/day/inhabitans
  Sugars : 135 gr/day/inhabitans
  Meat : 380 gr/day/inhabitans
  Milk : 355 gr/day/inhabitans
Energy consumption : 1.544 kWh/inhabitans
Vehicles : 7,5 inhabitans/vehicle
Gross national income : 1.700 US$/inhabitans
Demographic growth : 1,5 %
Children mortality : 53/1000
Analphabetism : 9,3 %
Gross national income distribution :
  Agriculture : 12,6 %
  Minings : 1,8 %
  Manufacturing : 36,5 %
  Construction : 4,3 %
  Services : 44,8 %
Installed electric power : 7.000 MW
Railways : 41.000 km
Roads : 400.000 km
Urbans subways : 41 km

1.2. Educational aspect

General information :

Number of people attending studies	6.000.000
Number of education institutions	41.000
Number of teachers in service	500.000

Distribution :

77 % state administration

23 % private administration

Students distribution :

primary and pre-primary levels	64 %
secundary level	18 %
upper level and university	11 %
others	7 %

Study duration :

primary (starts at the age of 6)
minimum 7 maximum 7

secondary level
minimum 5 maximum 8

engineering
minimum 5 maximum 6

Engineers in service : it is estimated that 21.000 engineers in active service work in Buenos Aires city and surrounding although these figures might not reflect reality due to the continous incomes and outcomes of the labour market.

2. INSTITUTIONS

In the Argentina Republic the permanent education for engineers is conduted by three types of institutions :

Universities

State entities

Private entities

A breaf summary of the work performed is here by described.

2.1. Universities

There are 52 universities - 26 state owned and 26 private owned - . The majority of wich have engineer grades of five to six years study and level equivalent to that of a master degree or superior. Engineer are not yet prepared to the level of bachellors. Practically all universities have poss-graduates courses attended by engineers in service. Many of this courses cover very specific topcis, but others also cover "enter-disciplinary" natures so as to prepare engineers and other professions for company managerment or states affaires.

We will summarize the most relevant or older experiences.

Buenos Aires State University.

It runs several institutes and schools on courses related to updating, improvement and to deepen. The majority of this courses are bach up with economic support given by some private, state or mix societies, as for exemple : State Railways; Gas State Company; State Electric Power Company; State Oil Company; State Roads Administration; State Sanitary Company; Military factorys; Steel Factorys, and enterprise chambers.

Rosario National University.

It rungs courses in its graduate deppartement supportet by metallurgies construction companies and regional public services.

Cordoba National University.

It rungs courses for graduates in several disciplines, particulary in theory of structures. It also dictates courses by mail on operation, research supported by the ministery of the Defense.

National Technologycal University.

This university has campuses in more then 20 places in the country. It constitutes a very particular university as it courses aim to the formation of engineers which work as technitians in the industry. It runs on night shift timetable exclusively. By means of this it is possible to benefit from the experience of middle command potencial and offers continous education at that level. Besides, this university counts with Graduate Departments in several of its regional divisions, where specific courses on metallurgics, road machinery, metals treatment, nuclear engineering, computers and other specialities are being tanghs.

The rest of the universities also perform courses for graduates although some of them are very recent. The duration of these graduate courses varies from six months to two years depending on each case to be able to visualize the preferences of the argentine engineers in connection with the graduate courses we will show a chart showing the graduate courses dictated by Buenos Aires State University :

Civil ingineering	19,41%
Electronics	0,94%
Metallurgics and Mechanics	35,45%
Mathematics and Stadistics	18,31%
Bussiness Administration Productivity	9,15%
Chemistry and Petroleum	6,34%
Geophysics,Geodesia and Hydrographics	1,25%
Others	9,15%

2.2. State Entities

The main state entities which perform continous education are :

- National Council on Technical and Scientific Research.
- National Institute in Agricutural Technology.
- National Institute in Industrial.
- National Comission of Atomic Energy.
- Marine Service of Research and Development.
- Ministery of the Defense - C.I.T.E.F.A
- Sciences National Institute Hydric.

There are some other institutions of minor relevance wich also offer training courses but of less importance. The concrete actions undertaken by these entities are very many and started a long time ago.

As an example,the National Commission of Atomic Energy,become relevant due to its Panamerican Metallurgical course,and its post-graduate course in Nuclear Engeneering both of which are ruled by it,as well as others minor courses on diverse specialities.

The rest of the entities contribute wich economic help for course support as well as scolarship,in the country and in foreing countries. Short term courses are also organized in their own dependencies to train own funtionaries as well as engineers in general.

Several times these organizations run courses supported by international institutions such as UNESCO , OIT , United Nations , OEA and others. Mention is also made of the Argentine Scientific Society,which has organized througt its Electrycal Center of Superior Studies,several courses for Electrical Engineers on topics for improvement "patronized" by Electric Services of Buenos Aires.

The duration of the courses run by these entities is very wide. Courses may very from one week duration to two years. Many of these are undertaken after work hours to enable engineers to attend them thus not disturbing their normal activities.

2.3. Private Entities

In Argentina there exist many private entities which offer continous education. Some are exclusively dedicated to train engineers in specific subjets of their profession. Others,dedicate interdiscipline courses on Bussiness Administration,Systems Analysis,Technical Work Organization,Accounting,Finances and several other subjects which aim to the upper command positions. A synthesis of the performance of older entities as well as the most important ones is herehy summarized. Special emphasis is put in put in the fact that some of these entities started their operations in wear 1941 while the Universities started theis permanent education about wear 1951.

Exact Sciences Engineering Foundation of the University of Rosario with the participation of the Metallurgic Industries.

Argentine Union of Engineers Association which support a Committee for the Education in Engineering which looks after studies and sistematization and promotes by means of conferences and continous education.

Argentine Institute of Petroleum which ammalgamates Petroleum Companies which operate in the country. It runs and promotes a diversity of courses.

Engineers Argentine Center of Buenos Aires City. It runs a variety of courses for engineers, some of them are extensive to others professionals as they are interdisciplinaries. It also runs courses on Plastic Arts.Cultural Activities as well as its participation in the society. It also performs an intensive political action by means of congresses to discuss technical and economical subjects.

Engineering Center of the Buenos Aires Province. It runs several courses for graduate on a variety of specialities.

Engineering Center of Cordoba Province. It runs several courses for graduates.

Argentine Institute for the Developement of Executives. This entity offers courses of short dutation for company employers,courses which are attended by many engineers. These courses have a variable duration and many last from one week to several weeks. It should be noted that this entity supports the administration School of the Argentine Republic for graduate,which since 1968 dictate full time course of long duration as well as international seminars of intensive activity and short duration.

Argentine Circle on Studies of Industrial Organization. It runs training course on the matter.

Chistian Association of Enterprise Managers. It runs courses and promotes specialization.

Argentine Center on Work Study Techniques. Courses.

Argentine Institute on Enterprise Administration. Courses.

Argentine Society of Perational Research. Courses.

Argentine Society on Industrial Organization. Courses.

Argentine Council of Scientific Organization. Courses.

Enterprise Administration Association. Courses.

Argentine Productivity Center. It work with founds from the National Institute of Industrial Technology and founds from international organizations.

Bureau des Temps Elementaires. Courses and studies.

Research Center of Applied Mathematical Techniques to Bussiness Administration. Courses and Publications.

Metal Stamping Research Center. Research and Publications.

Galileo Argentine Foundation. Various tasks.

Argentine Institute of Quality Control. Courses.

Compared Studies Center. Courses.

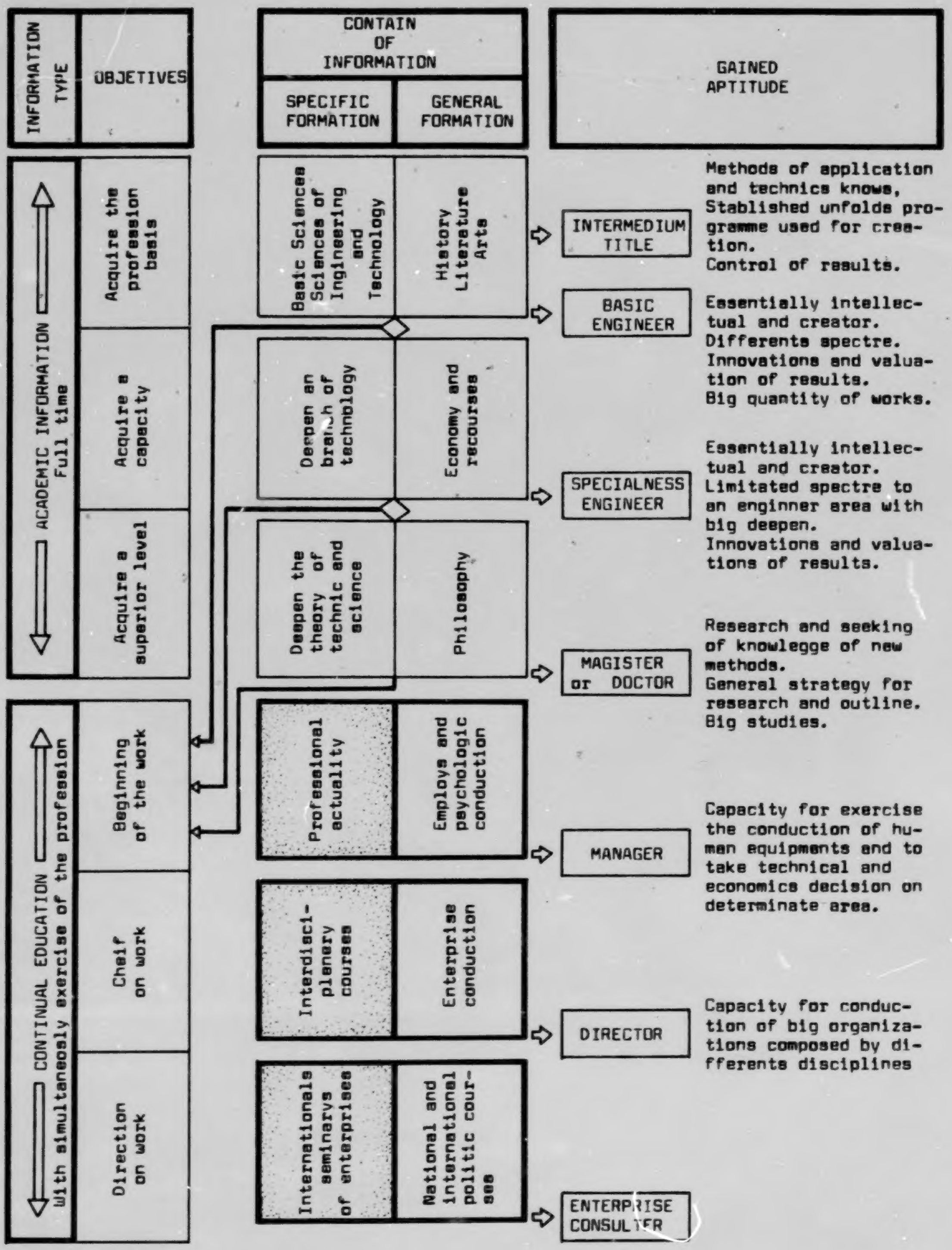
Various documents exist in connection with the specific activities of the mentioned entities. The majority of these entities also publish specialized magazines which are mailed to engineers thus contributing to continous education.

Particular mentio should be made of the professional entities which also produce continous education,for example,the Proffessional Council of Mechanical and Electrical Engineering publishes every two months issues known as "Energetic Sciences" which reachs all engineers under this orientation,and covers theoritycal and practical subjects and also includes latest developements. The same aplies with the issue "The Engineering" from the Engineering Center of Buenos Aires City which has a long tradition in Scientific Technical and Cultural matters. The Argentine Electrotechnical Association,and the Argentine Chemical Association also have issues which contribute to continous education. The Engineers Center of Cordoba has a magazine of the same characteristics,and many of the 30 engineering centers which exist in the Argentina,contribute with courses ando publicationes to proffessional updating. The proffesional council entities which monitoring the ethics of the proffession and are responsable for rule the proffession exercise,also have publications which contribute to recycling and specialization.

3. PROJECT

In view of the experiences achieved by the Argentine Republic,the author of this report propose the formulation of this matter on continous education for engineers to this UNESCO Con-

SCHEME OF ENGINEER CAREER


INFORMATION TYPE
OBJETIVES
CONTAIN OF INFORMATION
SPECIFIC FORMATION
GENERAL FORMATION
GAINED APTITUDE
ACADEMIC INFORMATION Full time
Acquire the profession basis
Acquire a capacity
Acquire a superior level
Basic Sciences Sciences of Ingineering and Technology
History Literature Arts
Deepen an branch of technology
Economy and recourses
Deepen the theory of technic and science
Philosophy
CONTINUAL EDUCATION With simultaneosly exercise of the profession
Beginning of the work
Cheif on work
Direction on work
Professional actuality
Employs and psychologic conduction
Interdisci- plenary courses
Enterprise conduction
Internationals seminarys of enterprises
National and international politic cour- ses
INTERMEDIUM TITLE
BASIC ENGINEER
SPECIALNESS ENGINEER
MAGISTER or DOCTOR
MANAGER
DIRECTOR
ENTERPRISE CONSULTER

Methods of application and technics knows, Stablished unfolds programme used for creation. Control of results.

Essentially intellectual and creator. Differents spectre. Innovations and valuation of results. Big quantity of works.

Essentially intellectual and creator. Limitated spectre to an enginner area with big deepen. Innovations and valuations of results.

Research and seeking of knowlegge of new methods. General strategy for research and outline. Big studies.

Capacity for exercise the conduction of human equipments and to take technical and economics decision on determinate area.

Capacity for conduction of big organizations composed by differents disciplines

ference,purpose the starting point is that the continous education cannot be studied separately from the engineering career.
It therefore becomes necessary to focus the complete proffessional life as a whole to be able to appreciate the different phases of the pathway.
The attached diagram proposes the main concepts. It is worth mentioning that at the same time that the engineer ages,his responsabilities therefore it is promoted that the training be oriented towards the areas of general administration.

Traslation to English: M.Z.P.Vedoya.

MARCELO A. SOBREVILA

Marcelo A. Sobrevila is a argentine electrical engineer.He has developed a long trayectory in argentine engineering private enterprise.Simultaneously,he has executed university works,he has writed books and articles in rewiew,and he has study the engineering formation into UNESCO fellowships.At present is professor in Buenos Aires University,and Technological University,and independent consulter engineer.

THE 3-D PROGRAMME: AN EXPERIMENT WITH CONTINUING EDUCATION AT DANMARKS TEKNISKE HOJSKOLE AND DANMARKS INGENIORADKADEMI

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Summary

The paper describes a programme for continuing education of engineers, consisting of courses selected from the curriculum of Danmarks tekniske Højskole and Danmarks Ingeniørakademi and offered in revised versions as evening-classes to engineers in practice at a relative low fee. In order to gain experience from the programme, information on its educational, economical, and professional background is essential to the reader. Part one of the paper therefore presents general information on the Danish engineering educational system and the Danish engineering profession. Part two presents the main characteristics and the results of the programme and part three summarizes the experience that can be gained from it.

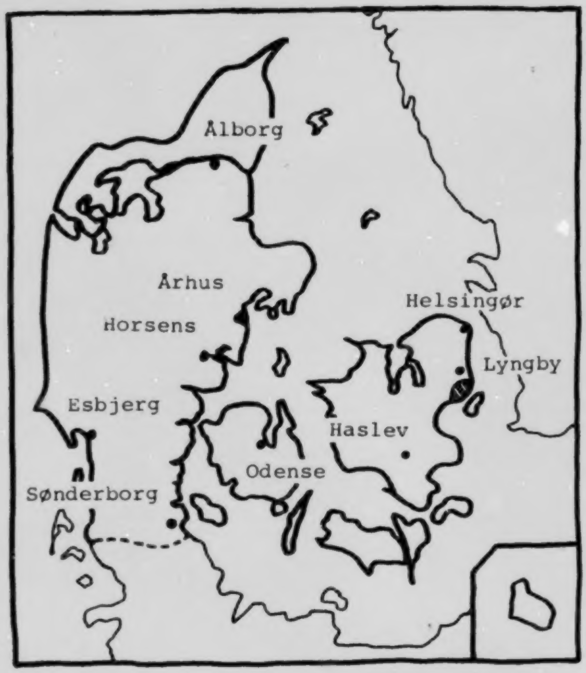


Figure 1: Danish Locations of Relevance to Engineering Education

Part one: General Information

Background

Denmark is inhabited by only 5 mill. people. It extends 300 km from east to west and 300 km from south to north. The country has no raw materials or natural resources; consequently it has to depend on extensive foreign trade in which agricultural and light industrial products play an important role. The country has a high technological level linked with a high level of general education; it has a strong tradition for adult, non-academic education.

The Danish currency is kroner (Dkr.); 1 US$ equals 5.00 Dkr. (1st November, 1978).

The Engineering Education

For many years there were two kinds of engineers in Denmark: Civilingeniører with an academic education and Teknikumingeniører with a practical engineering education. 20 years ago a new kind was introduced: Akademiingeniører, with a relative short academic engineering education. The map on figure 1 shows all Danish towns of relevance to engineering education.

The education of civilingeniører takes place at Danmarks tekniske Højskole (DtH) in Lyngby, 15 km north of the center of Copenhagen. The course is planned to last 5 years. During the period 1970-75 an average of 400 candidates graduated per year from DtH, which has a total of 520 full-time teachers and 3.300 students. DtH is aimed at research as well as at teaching. It should be noticed that the Danish word civilingeniør is used to indicate engineers of all branches who graduate after five years of study from Danmarks tekniske Højskole - and in the future also from Ålborg Universitetscenter.

The education of akademiingeniører takes place at Danmarks Ingeniørakademi (DIA) which is located at the same campus as DtH in Lyngby. Study is planned to last 3½ years. During the period 1970-75 an average of 275 candidates graduated per year from DIA, which has a total of 180 full-time teachers and 1.200 students. DIA is aimed primary at teaching.

Ålborg Universitetscenter was founded a few years ago on the basis of a number of institutions for higher education located in the northern part of Jylland. It comprises a faculty of Technology and Science within which frame as well akademiingeniører as civilingeniører are educated. Ålborg Universitetscenter admits approximately 250 engineering students per year.

The education of teknikumingeniører takes place at eight engineering schools, named Teknika (singularis Teknikum) situated in the following towns: København (900 students), Helsingør (210 students), Haslev (120 students), Odense (490 students), Århus (600 students), Horsens (220 students), Esbjerg (220 students), and Sønderborg (170 students). They provide a one year preparatory course and a 3-year engineering education, both full-time.

Danmarks tekniske Højskole is the only Danish engineering school having post-graduate studies giving a diploma. 10-15% of the candidates from DtH continue as post-graduate students for Den tekniske Licentiatgrad, which is the Danish equivalent to the Ph.D. degree. The average time of study is 3 years. Graduates from Danmarks Ingeniørakademi and Teknika may study at DtH for 1½ to 3 years to become civilingeniør or for 4 or more years to obtain Den tekniske Licentiatgrad.

The Engineering Profession

A young graduate will start his/her engineering career in Denmark with a salary around 100.000 Dkr. which is approximately the same as that of a skilled worker. An engineer at the end of the career will normally earn a salary around 150.-250.000 Dkr. However, many engineers are promoted to the management level, at which higher salaries are often paid. All kind of education in Denmark is provided by the government free of any charge. Taxation is very high; 45-50% tax on personal income is normal.

Table 1 shows the number of Danish engineers in 1975, by type of education and branch of engineering. Table 2 shows how engineers in Denmark are distributed in industry as per January, 1975.

In Denmark there is practically no special legal regulation of the engineering profession. The title Ingeniør is not protected by law, so anyone may call himself Ingeniør and may exercise the engineering profession. The titles Akademiingeniør, Civilingeniør, and Teknikumingeniør are, however, protected.

Danish engineers join together in two professional societies. Dansk Ingeniørforening represents engineers graduated from Danmarks tekniske Højskole and Danmarks Ingeniørakademi; it has 11.000 members which represent 70% of all graduates from the two schools. Ingeniørsammenslutningen represents engineers graduated from Teknika; it has 16.000 members which represent 70% of all graduates from Teknika. Both societies serve as a combination of a professional society and a union. They cooperate in publishing a weekly journal called INGENIØREN and in running the DIEU-organization for continuing education of engineers.

The Continuing Education of Engineers

Continuing education of engineers in Denmark is organized mainly by DIEU (Danske Ingeniørers Efteruddannelse), an independent organization founded by the two engineering societies. Its objective is to improve the professional and social qualifications of the engineer by developing and offering post-graduate education in short courses giving no diploma. The courses can be divided into two main categories: engineering subject courses and management subject courses.

The normal format of the DIEU-courses is the day-time seminar of a duration of between one day and one week. A typical course lasts for 3 whole days (20-25 hours) and has 20 participants. DIEU has a total of 4.500 participants at a total of 250 courses per year. The turnover is about 10

	Civil	Electrical	Chemical	Mechanical	Total
Akademiingeniører	787	586	517	628	2518
Civilingeniører	3839	2373	2430	2544	11186
Teknikumingeniører	6977	5106		9614	21697
Total	11603	8065	2947	12786	35401

Table 1

Number of engineers in 1975, by type of education and branch of engineering

	Civil	Electrical	Chemical	Mechanical	Total
Agriculture, food manufacturing industries	94	32	197	278	601
Chemical industry	141	90	474	281	986
Stone, clay, glass, textile, wood and paper industries	317	63	143	453	976
Iron and metal industries, engineering works	128	518	109	3282	4037
Electro-mechanical industry	26	1424	20	419	1889
Transport equipment	14	58	2	802	876
Public works and administration	2357	1222	238	747	4564
Building and construction	2520	422	88	907	3937
Trade and commerce	154	448	97	723	1422
Transport	172	569	13	268	1022
Education, libraries, research, etc.	618	869	654	981	3122
Professions	2795	793	188	1288	5064
Total	9336	6508	2223	10429	28496

Table 2

Engineers employed in Denmark, distributed in industry as per January 1st, 1975

mill. Dkr. per year. Table 3 gives information on the number of courses, number of participant-hours, etc. for the courses offered by DIEU in the fall of 1977 and in the spring of 1978.

The fee for a typical DIEU-course is about 130 Dkr. per participant-hour. DIEU is a non-profit organization and the fee covers salaries to teachers, educational material, rent of class-rooms, promotion and administration, etc. Many of the courses takes place in special centers for adult education, in which the participants stay during the course; the price for board and lodging is then added to the above mentioned fee.

DIEU has a permanent staff for development, promotion and administration of courses; it consists of about 20 members. 900 associates are employed as ad hoc teachers and members of advisory committees. The teachers come from industry, government- and public services, and from engineering schools, where they are normally employed full-time. The salary for teaching a DIEU-course is 280 Dkr. per lecture (45 minutes) plus extra for transport and note-writing.

	No of courses offered	No of courses accompl.	No of participants
Building and construction engineering	80	69	24500
Road and traffic engineering[1]	28	23	
Industrial engineering (Elec. + Mech. + Chem.)	113	73	21000
Management	95	84	50000
Total	316	249	95500

[1] By special arrangement between DIEU and the Directorate for Public Roads.

Table 3:

DIEU's activity in the fall of 1977 and the spring of 1978.

Part Two:
The 3D-Programme

Background

In the late sixties there was a general dissatisfaction among Danish engineers with the relative high fees of the courses arranged by DIEU. It was often claimed that these courses were so expensive that they could not be afforded by an engineer unless his/her employer agreed to pay the fee.

At the same time there was among many of the teachers at Danmarks tekniske Højskole (DtH) and Danmarks Ingeniørakademi (DIA) a wish to get into closer contact with practice by offering continuing education courses to engineers working in industry.

This led in 1973 to the establishment of the so-called 3D-programme which consists of courses selected from the normal curriculum of DtH and DIA and offered in revised versions as evening-classes to engineers in practice at a relative low fee.

Until 1972 the study at DtH had a rather rigid structure. Each subject was well coordinated with other subjects within a study-line and with Mathematics and Physics common to all lines. However, coordination of subjects belonging to two or more lines was difficult and gradually it became more and more desirable to be able to combine subjects in non-traditional ways and to introduce new subjects and specialities. In an attempt to solve these problems the structure of study was changed radically from 1972.

The new structure - the modular structure - aims at giving all subjects an equal status. The study is divided into modular courses arranged in such a way that each course carries the same load of work for the students. A modular course equals 56 lectures (35 minutes) distributed over a semester of 14 weeks. To obtain a degree as Civilingeniør the student has to pass the equivalent of 55 modular courses which corresponds to a length of study of 5 years. To all students 7 specific courses in Mathematics and Physics are compulsory. Furthermore they have to take at least 6 courses out of some 40-50 other courses offered within Mathematics, Physics, and Chemistry. They also have to prepare a thesis carrying a load of work corresponding to 5 modular courses. All other courses are in principle optional.

DIA also decided to change its structure to the modular system in 1972 even though a relative larger number of courses at DIA that at DtH have remained compulsory to all students.

What actually happened in 1972 was that all subjects taught at the campus of DtH and DIA were divided up into 6-800 modular courses of a relative short length. This made it feasible to offer some of the courses as continuing education courses to engineers in practice. DtH and DIA therefore joined in a decision to establish a continuing education programme for engineers working in practice on basis of the modular courses taught in the normal curriculum.

Financing, Administration

DtH and DIA are economically controlled by the Ministry of Education and as part of this control expenditures for and income from courses in continuing education are not allowed in their budgets. It was therefore decided to offer the courses as evening-classes and to set up a special arrangement that allowed the teachers to be paid for teaching the courses in their leisure time. The Ministry permitted to use the class-rooms and laboratory facilities of the two engineering schools for the courses free of any charge.

Another important problem was that of administration and promotion of the courses. DtH and DIA had very limited experience in this field and it was therefore decided not to establish a special office within the schools to take care of these tasks. Instead an agreement was made with DIEU, according to which the DIEU-organization undertakes these tasks on a payment-basis.

The responsibility for the programme was placed on committee especially set up for this purpose. In order to secure the best possible cooperation among all partners involved in the programme it was decided to compose the committee of representatives from DtH (two teachers and one graduate student) , DIA (two teachers and one undergraduate student) and DIEU (one staff-member and one board-member). The programme thus became a joint-programme of the three institutions DtH, DIA, and DIEU. Consequently, the courses were called the 3D-courses and the committee was called the 3D-committee.

The procedure in offering continuing education courses was established as the following: The teachers at DtH and DIA propose courses to the 3D-committee. The committee then decides whether or not to accept the course. If a course is accepted, the 3D-committee undertakes the financial responsibility for promoting the course and DIEU undertakes the actual work of the promotion. If a sufficient number of participants enroll the course, the necessary arrangements concerning administration, booking of rooms, payment of fees and salaries, accounting, etc. are done by DIEU. If a course is cancelled due to the fact that an insufficient number of participants have enrolled, the teacher receives no salary while DIEU receives a sum of money to cover the costs of promotion and advertisement.

According to this arrangement the financial responsibility for the 3D-courses rests within the 3D-committee while DIEU undertakes the administrative tasks.

A garantee fund for the programme was established on the basis of a donation from the private Danish foundation, Otto Mønsteds Fond.

Need Analysis, Promotion

The 3D-committee does not apply any systematical need analysis for the 3D-courses. Twice a year all teachers at DtH and DIA are asked to propose 3D-courses. The committee then selects those courses that according to its experience will be of interest to engineers in practice. In the process of this selection the 3D-committee might ask for advice from the advisory committees set up by DIEU or from engineering firms, government agencies, etc.

In some cases a 3D-course is developed by a teacher from DtH or DIA on basis of a proposal from the 3D-committee. However, it should be underlined that the committee has no authorization to order the teachers at DtH and DIA to offer 3D-courses since the courses are given in the leisure time of the teachers.

All 3D-courses are advertised at least once in the weekly journal INGENIØREN that is distributed to all Danish engineers. The 3D-courses are also advertised in a catalogue containing information on courses relevant to continuing education of engineers and distributed by DIEU to all Danish engineers and engineering firms. In addition, many courses are promoted by means of personal calls or letters to firms and persons in industry. All teachers offering a 3D-course are therefore requested to forward a list of firms and persons to whom the course might be of special relevance; this list is used for the latter mentioned type of promotion.

Format, Costs

A typical 3D-course runs for 12 weeks, one day per week, and 2 or 3 hours per day. The normal period of time for the course is between 4.30 p.m. and 6.30 or 7.30 p.m. This arrangement allows the participants to join the course directly after work. Courses arranged between 7 p.m. and 9 or 10 p.m. have not been attractive.

As a general principle the 3D-programme shall remain financial self-supported; the 3D-committee therefore maintains a strict budget control for the courses. This control involves the following parameters where all amounts quoted are referring to the fall term of 1978:

a. The participant pays a fee of 45 Dkr. per course-hour (45 minutes). This fee has been established on such a level that it corresponds to approximately 35% of the fee for a normal DIEU-course.

b. The teacher is paid a salary of 250 Dkr. per course-hour (45 minutes); this amount includes salary for preparation of the lectures, etc.

   In addition the teacher is paid a special salary of 2.000 Dkr. the first time a 3D-course is offered; this salary is paid for the effort made to establish the course.

c. DIEU is paid 90 Dkr. per hour for promotion and administration of the courses plus the expenditure for advertisements. For a course that has been cancelled due to an insufficient number of enrollments the costs of promotion and advertisements amount to 3000 Dkr. as an average. For an accomplished course the costs of promotion, advertisements and administration amount to 8000 Dkr. as an average.

d. All expenses for text-books, notes, coffee, etc. are taken direct into account for the specific course.

The minimum number of participants is calculated on basis of these parameters for each 3D-course as the number of enrollments necessary for the course to break even. The maximum number of participants is stipulated on basis of pedagogic considerations, the size of the class-room, etc.; normally not more than 25 participants are allowed at a course.

If the minimum number of enrollments for a course is not reached the course is cancelled, and the 3D-committee has to account for a deficit. If the enrollment reaches a number between minimum and maximum the course is accomplished and the 3D-committee can account for a profit. At the end of each semester the 3D-committee checks that the 3D-programme is breaking even. In case of a deficit the fee is ajusted and special care is taken to avoid offering courses for which the minimum number of enrollments cannot be reached. Profits are used to initiate new 3D-courses and as a garantee fund.

Staff, Enrollment, Evaluation

As mentioned above it is voluntary for the teachers at DtH and DIA to offer 3D-courses; approximately 10% of the teachers at the two engineering schools are or have been involved in the 3D-courses.

Being confined to the evening-class format the 3D-courses attract only participants living and working within a distance of 30-50 km from the campus of DtH and DIA in Lyngby. In practice this amounts to some 50% of all engineers employed in Denmark.

Enrollment comes from all three categories of Danish engineers with a slight overweight of civilingeniører. In some courses there have been enrollments from non-engineers such as technicians, pharmacists, etc.

At the end of each course an evaluation of the content and the teaching is performed by means of a questionaire distributed between the participants. The questionaire is primary for the use of the teacher whereas there is no systematic follow-up of the evaluation from the 3D-committee.

Results

3D-courses have now been offered for 10 semesters. Figure 2 illustrates some of the main results. The average number of participants at 3D-courses is 20. In the fall term of 1977 and the spring term of 1978 the total turnover was 500.000 Dkr. The following course-titles indicate the most popular 3D-courses: Methods of Statistical Analysis, Statistical Design of Experiments, Design of Concrete Structures, Protection of Buildings Against Fire, Solar Heating in Denmark, and Micro-computer Science.

Part Three: Experience, conclusions

The following conclusions, drawn from five years of experiences with the 3D-programme at Danmarks tekniske Højskole and Danmarks Ingeniørakademi may be of use to planners of programmes for continuing education of engineers. However, special care shall be taken to evaluate the conclusions on basis of the educational, economical, and professional background of the 3D-programme.

a. At least 5-10% of the courses taught in an undergraduate curriculum are of interest to engineers in practice.

b. At least 10% of the teachers at an engineering school have an interest in teaching continuing education; their main motive is to get into contact with engineers employed in practice, however, the economical motive shall not be underestimated.

c. The evening-class format of the once-a-week-direct-after-work type is attractive to many engineers employed in practice - and to employers.

d. Very few participants pay the course-fee out of their own pocket; for evening courses there seems to be relative few problems in getting the employer to pay the fee.

e. For promotion and advertising of a programme for continuing education professional assistance is necessary; such an assistance is not often found at engineering schools.

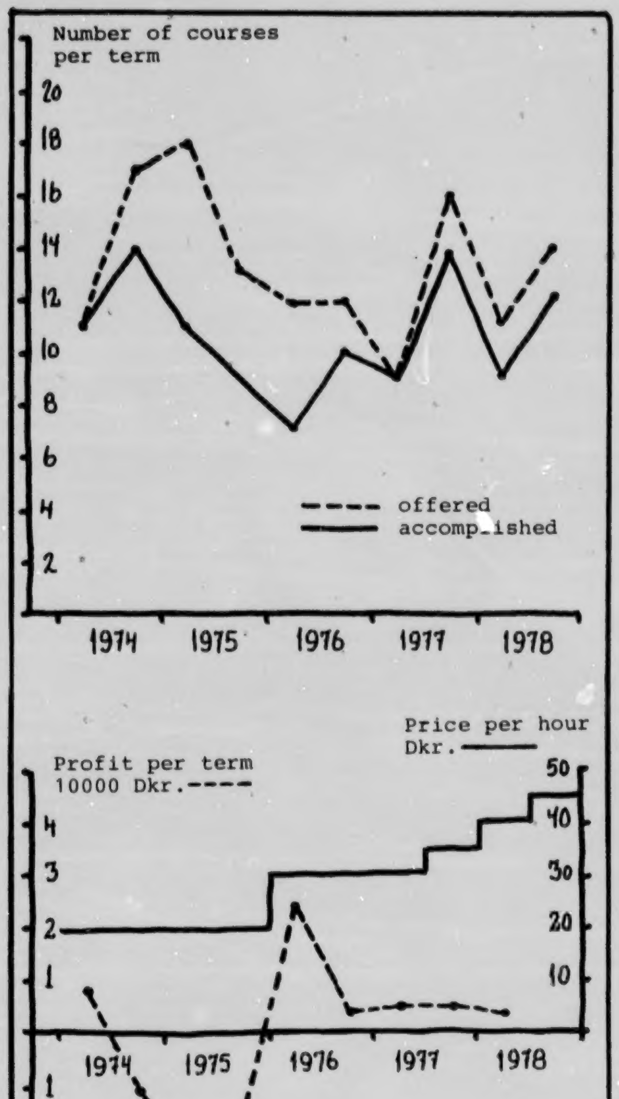


Figure 2: The results of the 3D-programme

f. Strict budget control is extremely important; easy ajustments of the fees, etc. must be possible.

It can finally be added that no problems have been encountered in having the 3D-programme running parallelly to the DIEU-programme. This is probably related to the fact that the courses of the two programmes differ in format and in price.

NIELS KREBS OVESEN

Born 1934. M.Sc. 1957 and Ph.D. 1961 from the Technical University of Denmark. 1968- professor in Soil Mechanics at the Danish Engineering Academy. 1972- chairman of the Committee for Continuing Education at the Technical University of Denmark and the Danish Engineering Academy. 1977-1979 President of the European Society for Engineering Education.

CONTINUING ENGINEERING EDUCATION IN DEVELOPING COUNTRIES

Dr. M.L. Jain
Principal/Director
Thapar Institute of Engineering and Technology
Patiala (Punjab), India

Summary :

In developing countries, under the traditional system, education used to be on the job, life long and integrated with life's work. With the introduction of modern system, the emphasis shifted to the education of the child and the adolescent who was taken out of his community milieu, given imported knowledge and trained for anciliary administrative, technical, clerical and teaching functions. This elitist and rigid system has led to serious socio-economic problems which can only be mitigated by life-long continuing education. Engineering Institutions in every country should play their role in organising continuing technical education programmes at all levels. International communication and cooperation is essential in this great human effort. This First Conference on Continuing Engineering Education is an important step in that direction.

Traditional System of Education in Developing Countries :

Before the introduction of Western system of education in developing countries, learning, wisdom, tradition and custom, which together formed the substance of culture and civilisation were passed by word of mouth from generation to generation. There were no schools as we know them. Education was direct i e learning used to be on the job and life-long. Elders, reformers and leaders preached their ideas to adults. The learned continued their education through self-study of scriptures. Emphasis was on the education of the adult rather than of the child or the adolescent. One's life, work and study-experience were completely integrated.

Modern System of Education in Developing Countries :

With the introduction of modern education in schools and colleges, the emphasis shifted to the education of the child and the adolescent. It took the student out of his community milieu and prepared him in an artificial setting for work in the modern sector for anciliary administrative, clerical and other technical functions or for teaching. Teaching drew its contents largely from imported knowledge and scholarship, was devoted to work on texts and not to the study of the real problems of life. Learning was more a way to status and had minimal links with native culture. On the other hand, a rapid absorption of some of the elements of the technological culture have resulted in marked contrasts of 'traditional' and 'modern'.

Crisis of modern education :

Because of fast growth of youth population in developing countries, the demand of education as also the enrolment has been rising. So has been the rise in expenditure on education. Over the past about two decades educational expenditure has been growing at-least twice as rapidly as the national economy and over-all public budget. Because of other pressing needs like health, housing, national security and defence, growth of educational budget has begun to slow down. On the other side of the economic squeeze is the rising cost per student due to steadily rising cost of labour and material. Thus the education system is faced with problem as to how to improve efficiency and productivity by better utilisation of available resources.

Due to the structural rigidities

and imperfections, which characterise the economies of developing countries, their theoretical manpower needs for growth far exceed what the employment market actually demands and can pay for. This imbalance between demand and supply results in wide spread unemployment and frustration amongst the educated which often manifests itself in students unrest. It is clear that educational system has to take account of prospective manpower needs and job opportunities.

The maladjustment of education system has another aspect i e what is being taught and how it is being taught. What is being taught is absolete in terms of what today's students will require to live effectively in the last two decades of the 20th century and well into the 21st. Moreover, what is being taught is irrelevant as well, viewed in the cultural, social and economic context of the particular nations and students concerned.

The teaching methods and educational logistics, in short, the educational technology, which were originally designed to serve a relatively small and homogeneous group of 'elite' students does not fit a much larger and far more heterogeneous student cliental. Standardized curriculum, examination system, chronological academic lock-step, teacher-student ratio and all the rest of pedagogical paraphernalia of an earlier era are no longer relevant to present day mass education. What is needed, quite obviously, is a much more flexible and diversified set of pedagogical arrangements.

Continuing Education and Economic Development :

The need of reform for the introduction of innovative measure is thus clear. No formal education system, however, renovated can convey all the information one will need throughout one's life. Students studying today will have to be retrained for new jobs several times during their working life. The rapid technological and sociological changes in today's world make life-long education a necessity. Therefore, the organisation of continuing education of adults is becoming increasing important in all societies.

Developing countries are striving for faster economic growth to have self-sufficiency and self-reliance. These countries have set for themselves over-all target of 6% or 7% growth rate of their GNP which is broken down to 4%-5% growth rate for agriculture and 8%-9% rate for industry. This rate of growth of industrial production will involve a comparable increase of higher and middle level technical personnel of all kinds - engineers, technicians, and an improvement in the quality of labour force as a whole.

Under the circumstances, business and industry, professional bodies, defence services, trade unions, social groups and other organisations are becoming increasingly aware of utility of continuing education for developing the competence of their members.

Continuing Education and Responsibilities of Engineering Institution :

General functions of continuing education of engineers and technicians may be briefly stated as under :

a) Improvement of professional competence;

b) Training for management role;

c) Training to face socio-political changes and to fulfil desire for personal cultural advancement.

It need hardly be pointed out that the engineering institutions have the necessary talent, equipment and infrastructure to fulfil these functions with the help of their own faculty and some experts from the field or other institutions. It is only appropriate that these institutions fulfil this obligation, to society which have been maintaining these institutions at a huge cost in poor developing countries.

In fact, the institutions of higher learning including the engineering institutions have been slow to realise that they have a fundamental role to play in research, in design of curricula and teaching materials, and training of instructors and teachers. Engineers have to cooperate with social scientist and apply their special knowledge to new problem constallations connected with the development of job-oriented adult education at all levels. It must be understood that there is no shortage of people who are willing and able to learn. The bottle-necks are in the training of teachers,in the design of programmes, in the production of reading matter and teaching materials. In other words, the constraints are precisely in the areas where the highest level and the interdisciplinary skills are needed. The effort on the part of engineering institutions will give the faculty fresh insight not only into their normal academic activity but also their whole outlook to entire process of engineering education.

In other words, continuing adult education in engineering institutions should not be considered as an anciliary activity but essential social responsibility which they cannot afford to neglect.

Continuing Education and Benefits to Engineering Institution :

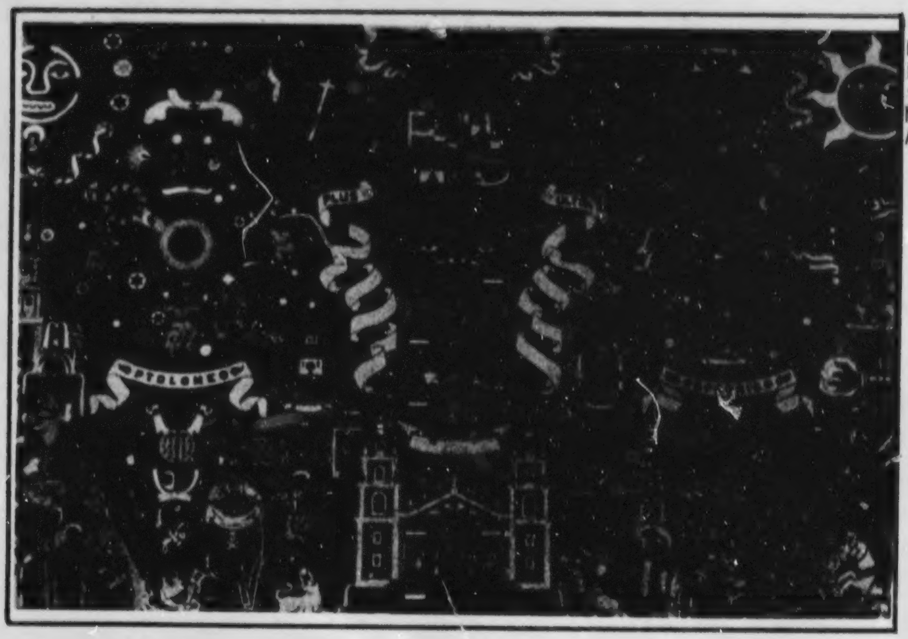
The emphasis on service to society, have tended to disregard how much the institution themselves gain from involvement in continuing education. The teaching faculty, who come in contact with grown ups with considerable knowledge and experience, learn a lot from their students. In fact, adult teaching is not monologue but a dialogue, there being no teachers but only fellow-learner The atmosphere in the class is more democratic. Courses get modified when adult react critically or negatively to the material. New courses, having been tried and found useful in continuing education programme, are introduced in the regular curriculum. In fact, this interaction has a very healthy effect on normal teaching and research in the institutions and make them more relevant to the actual needs of industry and society. This will slowly remove the complaint of the institutions being insular and elitist.

Continuing Engineering Education and International Cooperation :

Continuing Engineering Education is obviously an important and urgent task facing every developing country, which it can neglect only at a great national peril. It should invest all the national effort for its planning and development and seek information and assistance from the experience of other nations. There is thus an urgent need to develop international communication and co-operation in the field of continuing engineering education. This First World Conference on Continuing Engineering Education will surely prove to be an important beginning of a great international effort.

CONTINUING EDUCATION IN SOCIALIST COUNTRIES

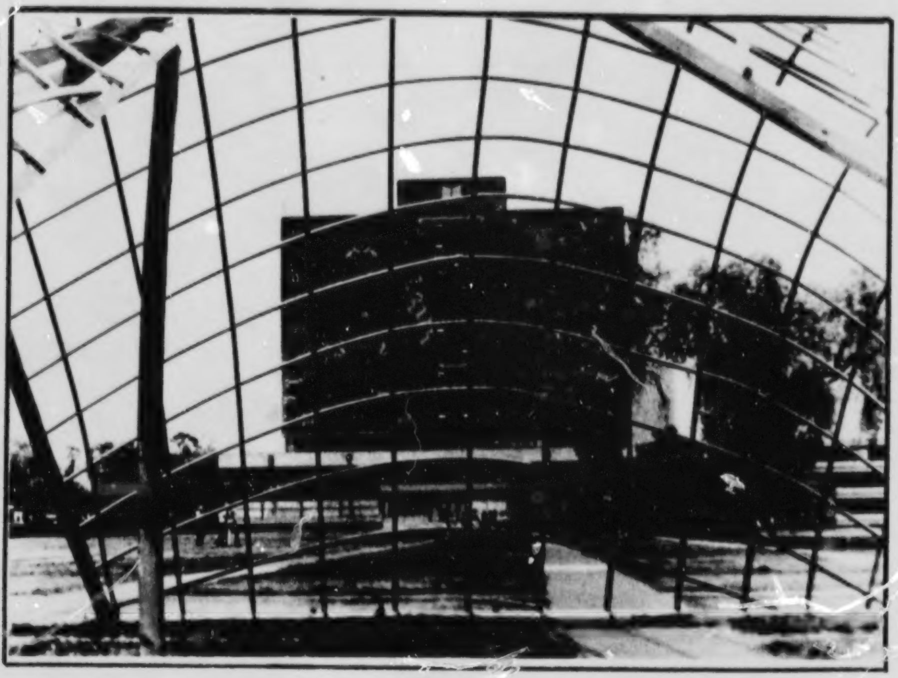
Mr. T. Biernacki
Rector
Politechniki Gdanskiej
Poland

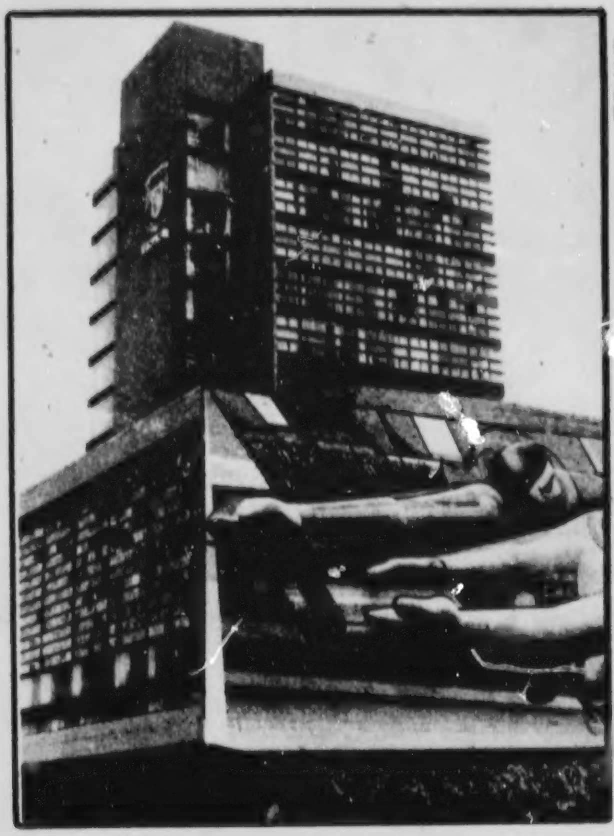


Mosaic Decoration on
Library Building at
the University of
Mexico
Artist- Juan O'Gorman

SCENES FROM MEXICO

Library Building
The University of Mexico

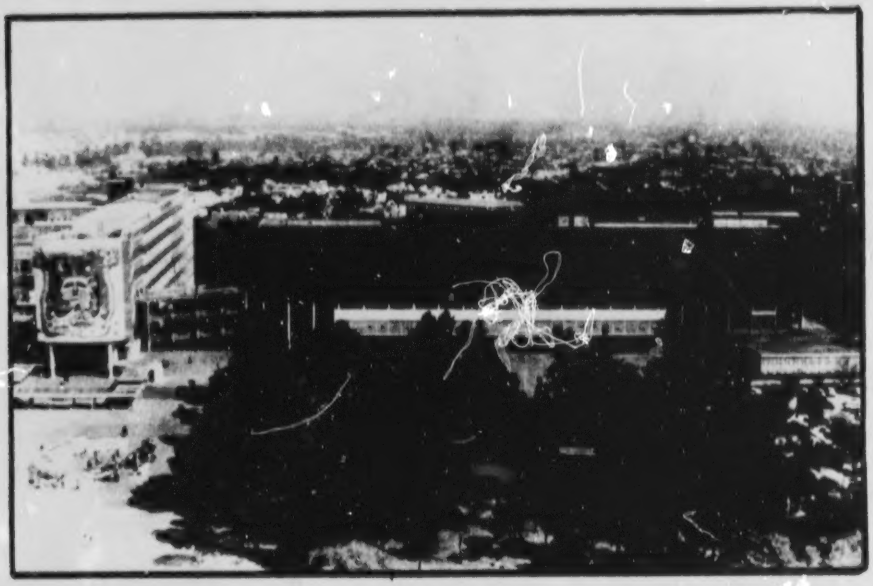




Relief mural by
Sigueiros on the
Administration Building
University of Mexico

SCENES FROM MEXICO

The University of Mexico



SESSION 4C

GROUP III
INDUSTRY/GOVERNMENT PROGRAMS

Joseph M. Biedenbach
Director, Continuing Education
For Engineering
University of South Carolina
Columbia, South Carolina

INDUSTRY

A. Growth of In-House Programs

The growth of in-house programs in industry over the past decade has been quite substantial, particularly in the large industries. There are many reasons for this but most large industries are beginning to realize the need for constant updating of technical people in their organization and to help lower their resistance to change in an ever changing technological society.

The industry in-house programs are verv well defined because it has become obvious to the people within the industry what their educational problems really are if people are not working efficiently and with increased productivity. Education will not solve all of the problems that industry faces with the new technology but it is a place to start. The in-house education programs are usually highly successful for a variety of reasons.

- The needs of the employees are very well defined from an educational point of view, and the industry does not have to worry about the overall education of the person. They just zero in on the educational needs for the moment and develop a program that will meet these objectives rather quickly.
- There are no prerequsites for any course that the industry develops. They give the programs to people who have a need to know and do not worry about upgrading those people who perhaps could do the job if some prerequisites were taken first.
- Industry does not differentiate between employees. If the technologist needs to know something about differential equations, they are in the same classes as the engineers who need to know something about differential equations. It is sometimes hard for academic personnel to realize that industry is interested in solving the problem and are not worried about degrees, accreditation of their programs or worry about the validity fo their graduates. If the graduates can do the job upon completion of the course it is good enough. They do not worry about many of the other details that they hope the universities do to maintain their accreditation.
- Industry is interested in training the largest number of people for the lowest possible cost in those areas of expertise that are needed in their own organization. They can educate a larger number of people with the same dollars it costs them to send a few people to special short courses and other programs within the university. Once these people return to the work environment they often cannot communicate effectively with the people who did not attend the educational program. Thus in-house programs have a great deal of appeal to them.
- Participation in in-house programs solves one of the major stumbling blocks to university programs: personal motivation. If the chief engineer and plant manager give an impression of being interested in people participating in education employees participate. It is as simple as that. By presenting programs in-house after hours, lunch hours, or even during some part of the workday, people are motivated to participate because they do not have any travel time, it does not cost them anything, and it does not infringe upon their free time as much as the university program does.
- The programs that are developed in most in-house situations are centered around real life problems within that industry. The instructors are well qualified and are the participants' peers who work with them. They respect each others' judgment, and this author has found that instructors from industry seem to talk up to the students rather than down to them and this is not always true of academic personnel.
- Most industry instructors for in-house programs have little hangup on techniques that are used for educating people. They will use anything that works and thus reduce some of the problems that are associated with university education.

- Although industry in-house programs cost a lot more than they are willing to admit, these costs can be hidden in all kinds of budgets within an industrial organization. A good case could be made that it is cheaper to send the individual than it is to train him within the plant, if one looks at all of the costs. This is very difficult to do because of accounting systems.

B. Payoff for Participation in CEE

The payoff for participation in continuing education is still the biggest stumbling block to motivating people to participate. Industry does not promote or give pay raises to individuals just because they participate in continuing engineering education programs. The payoff is on job performance during any given year. If this begins to slip, the individual does not receive a merit increase nor is he promoted. Job performance is the key to all industrial promotions on the average. There are exceptions to this but people who get promoted for other reasons usually do not remain with an organization very long once they are "found out".

A great deal of additional research must be done on determining the payoff for participation in continuing engineering education. There has to be some intangible benefit for participation in continuing education which is at least evident to through self evaluation. NSF may find this a fertile field for future research projects.

C. Industry Use of Multi-Media Programs

Industry and government have probably made the most efficient use of multi-media programs of any of the major institutions in our society. The reason is that they have specific requirements which are very well defined, indicating which employees need a particular educational experience. The military has probably led the way in the development of multi-media materials to train their personnel. The major reason, of course, is that they encompass large numbers of people who need the same kind of educational or training experience and also are widely dispersed; therefore, it behooves them to develop a program which they know will work and then distribute it widely to all personnel who require that particular skill.

Industry has a unique problem in that they are profit oriented and the training dollar must come from that source; therefore, they are very careful to insure that the educational experience is the best possible cost-effective method of getting the information across. This leads to difficulties at times, however, since training directors can develop tunnel vision and overlook the difference between cognitive and affective learning. They are chiefly interested in short-run objectives, and one wonders why they are surprised when employees do not grow and do not maintain their professional vitality as planned. I believe it might be inappropriate here to discuss what is the engineer's job. Alden Jones has deftly defined it by stating: "The job of the engineer is to design a product to meet a customer's need and which could be manufactured at a profit." I believe this is an important concept to which the universities must address themselves in the near future if they hope to maintain their viability in the continuing education market and to develop the multi-media programs required to do the job.

Dr. Lindon Saline from General Electric has done a study within the company and determined the factors leading to improved engineering and scientific performance in the following manner:

80%	Work Assignment
10%	Coaching and Supervision
2%	Career Planning
5%	Education
2%	Others

Although these figures are in the nature of educated guesses based on wide experience, they indicate to most engineers in what priority their efforts should be placed in order to progress and to improve their performance. This means that 5% of the effort that the engineer or scientist should spend on his education must be very efficiently scheduled. Multi-media techniques can expedite this; therefore, the "Not invented here" syndrome has less effect on their planning.

Below are listed, with a brief description, some of the better types of programs utilizing multi-media techniques currently being used in industry. The reader should realize that this is not an exhaustive list, but is a representative sample of the programs which have been used successfully in companies throughout the United States.

RCA

RCA was one of the first companies to utilize very extensively videotaped programs for training engineers. Their unique problem required updating and maintaining professional technical knowledge for approximately six thousand engineers deployed throughout the world. Specifically their need was to develop those programs that would maintain basic skills so that engineers could be transferred from one related technology to another as it developed from research laboratories.

They decided on video tape as the best method since it was easily transportable and relatively easy to make. With a modest investment of less than $75,000.00 for a three-camera, black and white TV Studio, they were able to produce a series of courses for less than $10,000,00 each. In addition, they were the first organization to pioneer the concept of a systems approach to the educational process. Not only did they make video tapes, but a text book was assigned for each course. A workbook was given to each student which contained replications of all the slides that were on the video tape cassettes. The tape stopped every ten minutes, and active participation on the part of the viewer was required in solving a problem which answered questions that were on the tape. Written assignments were given f for each period to be returned to a central location for grading and comments by a knowledgeable expert in the field. Letter grades were not given, but rather encouragement was indicated in the remarks to motivate the participant. Quizzes and examinations were peiodically placed in each of the programs. Although no grades were recorded nor entered in the personnel file, the learning experience served as a motivating factor and enabled the participant to assess his own achievements.

It might be noted here that this particular system has served as a model in many of the programs that have been developed since, and along with the SURGE program at Colorado State, probably has set the pattern for video taped instruction as we know it today.

Union Carbide

Union Carbide is another company which has utilized the video tape media to get information disseminated to all of their plant sites. They have developed a high quality series of video cassettes concerning energy conservation in industry and the various machines which they use in their own facilities. This has been accomplished at very low cost compared to university type operations and is quite effective. Both the RCA and Union Carbide programs are examples of what can be done inexpensively, with an eye on the "bottom line" of a budget sheet, and still be educationally effective.

Sandai Laboratories

Sandia Laboratories probably has the best technician training/education program of any industry in the United States. They utilize study carrels, individualized instruction video-tape, and 35 mm slide and filmstrips for their program. They probably have pioneered in industry the whole concept of criterion-referenced educational endeavor, clearly indicating the necessity of defining the problem and all of its constituent steps so that the training effort can be maximized. Evaluation of their programming indicates that they achieve very close to 100% competence after the training. It is important to note here that the industry makes no distinction between the engineer, technologist or the technician, if those individuals "have a need to know".

Bell System Training Center

The Bell System Training Center in Lisle, Illinois has probably the best system for simulation of technological problems of any training school in the country. They are able to simulate technical failures in a typical telephone system. Engineers must be able to determine from remote locations the cause and effect of such a breakdown and repair it as quickly as possible to preclude the loss of revenue during down time. The educational staff at the Bell System uses a very sophisticated technique to determine the needs and assess the program once it has been implemented. Much could be learned from study of this system at this training center on the use of simulation of problems. This author has seen no other location where more cost effective education is being performed.

Texas Instruments

Texas instruments is very deeply involved in video tape instruction, especially for training in electronic programs. They have a very active

development of video tape programs for their employees, and have become so successful that a spinoff of their business enables them to merchandise the material for sale in other industries.

Hewlett Packard

Hewlett Packard has a series of electronic media programs on circuitry that probably makes the best use of visual aids this author has seen for illustrating circuit diagrams and what is happening in an electronic circuit at any given time. Their overall use of visual aids is unsurpassed.

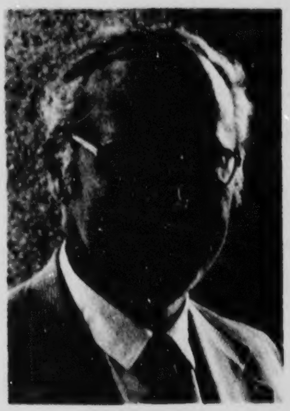
Xerox Training Center

The Xerox Training Center in Leesburg, Virginia is probably the most up to date and modern training center in the country using multi-media techniques. A wide gamut of programs has been developed using audio tapes, slides, individualized instruction and other techniques. Their video tape in-house distribution system at the training center is the finest in the world. In addition, the Xerox Corporation in Rochester has a group working on individualized instruction, using 35 mm slides, audio tapes and program materials that are second to none in quality and versatility.

The one characteristic of all the programs listed above is that the goals and objectives of all the programs developed by industry are very well defined before they start to put the program together. They do not simply take "another lecture" and put it on video tape. They are fortunate in that they know their "Audience" quite well, have defined the problems, and are not interested in training large numbers of people outside their organization who may have diversified interests. This makes the job much easier and allows multimedia presentations to be used quite effectively.

It should be noted here that industry has many non-degree people employed as engineers, although it would appear that only baccalaureate level engineers are hired for such job classifications. Again, media-based training programs are used to update and fill in necessary technological information as needed. Since this has proved to be a practical and economical solution for industry, many of the present "on paper" require--

ments will be inevitably phased out. Additionally, many individuals are not aware that present government regulations covering Equal Opportunity Employment and Affirmative Action hiring will ultimately force industries which have not alrealy done so to drop some of the "paper" requirements, regardless of opinion and convictions to the contrary.



Joseph M. Biedenbach received his Ph.D. from Michigan State University in Higher and Adult Education. He has served on the faculties of General Motors Institute, Purdue University, Florida Atlantic University. He served as Associate Dean of the Indianapolis Campus of Purdue University, Director of Education Resources for the Milton S. Hershey Medical Center and currently is the Director of Continuing Education for Engineering and Health Sciences at the University of South Carolina. Industrial experience includes a research physicist for A.C. Spark Plug Division of General Motors Corporation, Director of Continuing Education on the corporate staff of RCA Corporation, and supervisor of construction for American Bridge Company.

AN INDIVIDUALIZED INSTRUCTION APPROACH TO CONTINUING EDUCATION FOR ENGINEERS BY INDUSTRY

Frank B. Donalson
Manager Technical Training
NL Petroleum Services, NL Industries, Inc.
Houston, Texas

It is a pleasure to be here today and to share my experience with an individualized instruction approach for training engineers. As all of you here know, any instruction approach cannot really be understood outside the context of the environment in which it is used. So before discussing my organization's training system, I'd like to briefly describe my company and our training facilities...

We are a worldwide, multi-divisional firm that provides petroleum products, equipment and services. Our 12,000 employees include nationalities of many different countries. We are a growth oriented company, and by 1982, we project the total number of employees to increase to a total of 25,000.

NL Petroleum Services is only one operating unit of NL Industries, which is also active in chemical and mineral production, as well as manufacturing. Total annual sales last year amounted to 2 billion dollars.

All of the formal classroom training for NL Petroleum Services takes place in Houston, Texas. We transport employees from every continent to our center there and pay all the employee's expenses. Training materials are prepared in several languages, and although most courses are designed by us to meet specific needs, occasionally we find it necessary to supplement our in-house offerings with university courses and presentations by consultants.

In 1978, 2,500 employees attended technical, sales, and management courses in Houston. By 1982, the annual training load is projected to exceed 6,800. To handle this training load, we are presently constructing new facilities on an 86-acre site adjacent to Houston Intercontinental Airport. Including the living facilities, which will be provided, training areas will consist of about 200,000 square feet under roof.

The training facility will provide individual study areas, laboratories for hands-on training, conference rooms, areas for media preparation and printing, offices and recreation spaces. We have even included office space for guest speakers. Although most of our courses are functionally designed in-house to meet specific needs, we do find it necessary to supplement the training with consultants and university courses.

Training materials are written in several languages since employees are transported from every continent to Houston for their classroom and laboratory work.

Although our present commitment to training is considered unusually large for the industry and our relative size, the new training complex will probably have to be expanded again in 1982 to meet anticipated company training requirements.

Now that you have a little background on my company and training facility, let me tell you about our training system. Major goals for training are to:

(1) Teach skills that are applied at the well site, while the customer drills for oil and gas. This assures proper use of our products, equipment, and services.

(2) Prepare personnel for growth opportunities, in line with our policy of promotion from within for line management positions.

In 1974, I was given the responsibility to evaluate training methods and develop a system of continuing education for Engineering personnel which would support company growth plans.

Without going into detail, this study resulted in changing from teaching a series of conventional (lecture) type courses to:

- A multi-phase training system
- Individualized instructional methods using the modular approach

As anticipated, we experienced considerable resistance from instructors in changing from conventional lecture methods to the individualized modular concept. In time, this resistance disappeared when class averages improved and as the average time required for training shortened. I will tell you more about these improvements after explaining how the multi-phase training system works.

Multi-Phase Training System

We operate under the principle that some training is most effectively conducted on the job and some is more effective in a formal classroom. The multi-phase training system defines requirements for both on-the-job and formal classroom training and progressively ties it all together.

The training method in each case is the individualized modular concept which permits employees to progress at their own desired rate.

The phases of training may vary according to the needs of a particular organization. The application I use here is for my present organization.

PHASE I - Concerned with introducing the newly hired Engineers to the company. The training is conducted in the field under the supervision of the local manager. The training covers orientation for the job, the company, and the Petroleum Industry. The Engineer must complete 15 modules before acceptance into Phase 2. Average completion time is two weeks. This is also a screening period to determine if the trainee is satisfactory for the job.

PHASE 2 - Formal training conducted in the Houston Training Center. We build skills and teach the principles of product applications. There are 50 modules and average completion time is one month. The employee is given a promotion with satisfactory completion of Phase 2.

PHASE 3 - Conducted in the field under the supervision of the local manager. This phase contains 200 modules and is concerned with the practical application of the technology learned in Phase 2. Completion time requires up to one and a half years. Up to three promotions may be earned during this phase.

PHASE 4 - Advanced formal training conducted in the Houston Training Center for personnel that have satisfactorily completed Phase 3. There are 25 modules in this phase and average completion time is three weeks.

PHASE 5 - Career planning and preparatory training for entry into sales, supervision, or technical consulting. Phase 5 training is conducted in the field. Institutional courses are used to supplement this training.

PHASE 6 - Supervisory, sales, and advanced technical training. These courses are conducted in the training center and supplemented by Institutional courses.

PHASE 7 - Management training. These courses are conducted in the training center and supplemented with university courses and consultants.

At this time, sales or management training are still taught conventionally, and not individualized with our modular approach.

The major objective of our multi-phase training system is to provide continuing education and growth opportunity for employees that have the ability, interest and stamina to continue their personal development.

Now to explain the individualized Modular Training Method that has made the multi-phase training system so effective.

What Is A Module

In my system a module is one of many segments of information required to learn a skill or complete a course. These modules are sequenced to take advantage of the most effective learning processes.

Anatomy Of A Module

Each module contains:

(1) Subject Title

(2) Prerequisite for each module

(3) Provision For Instruction signoff

(4) Objective-precisely what is required to satisfy this module

(5) Criterion Test-what performance must be demonstrated to be checked off on the module

(6) Resource reference materials

Example Of A Module

NL Baroid Petroleum Services

A Criterion-Referenced Course

Drilling Fluids Technology, Phase II
Prerequisite C-A2

Name____________________
Instructor Sign-off____________________

C-B2
STATE COMPOSITION AND FUNCTION OF COAT PRODUCTS

OBJECTIVE: Given all available resources, you must be able to write the function and composition of the following COAT products: 777, 888, 311, 113, 415, and 45.

CRITERION TEST: Write the function and composition of the following products and check your answers with an instructor.

COAT 777 -

COAT 888 -

COAT 311 -

COAT 113 -

COAT 415 -

COAT 45 -

RESOURCE: Product Data Sheets on 777, 888, 311, 113, 415, and 45

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Course Map

Each course has a course map that shows the sequence for working each module.

Example Of A Course Map

Participants are permitted to work any module as long as he/she follows the proper sequence. We have found trainees highly motivated when they have control over their progress.

What Is Individualized Modular Instruction

I do not want to give the impression that I am opposed to the conventional lecture methods. We have used the lecture method of instruction for many years and will continue to use it on occasion. The following comparisons of training methods and conclusions regarding their effectiveness are based on studies and experiences in my company. I do not advocate Individualized Modular Instruction for all training situations, however, we have found it to be the most effective training method for our needs.

From my company's experience, here is a comparison of Conventional lecture with the Individualized training method:

TRAINING METHOD COMPARISON

ITEM	CONVENTIONAL	INDIVIDUALIZED
Subject Presentation	Lecture	Modules
Learning Mode	Group	Individual
Performance Standard	Teacher Discretion	Job Related Criterion
Progress Feedback	Periodic	Continuous
Course Orientation	Teach Knowledge	Teach Skills
Trainee Progress	Group Rate	Self Paced
Training Time	Constant	Variable

In teaching Engineers a highly specialized technology to represent the company throughout the world, it is extremely important that each Engineer receive the same training. We found that Lecturers varied their subject matter from one class to another, and there was no consistency in training.

Some lecturers argue that trainees in a classroom learn from questions asked by other trainees. In answer to this criticism, we analyzed our jobs very thoroughly and defined training requirements, and then sequenced the information to make it available when needed by the trainee. Our experience showed classroom questions tended to be disruptive and slow other trainees down. Many of our trainees were irritated by such distractions that interrupted their progress.

Here are some other points to consider in understanding the Individualized Modular Instruction Method:

* A TRAINING CONCEPT rather than just a training method. It involves all the planning and execution processes of who, how, when, what and why.

* OBJECTIVES are carefully and clearly written to define the exact performance required to complete each module. In my opinion, defining training objectives is probably the weakest link in most programs.

* SEQUENCING modules are presented in a logical learning order.

* UPDATING is as simple as rewriting modules. The system encourages updating to keep abreast of changes in products and technology.

* CRITERION TESTS for each module tests only the information defined in the objective. There are no equivocations in our tests. We are teaching saleable skills and we do not have time to play games.

* FEEDBACK is immediate on each module. Progress is constantly known in the course. This is a very important motivation.

* INSTRUCTOR FUNCTIONS AS:

(a) Course Manager

(b) Motivator

(c) Coach

(d) Resource

* SELF PACED since each trainee can progress at his/her own rate. This allows for differences in learning ability, interest, and desire.

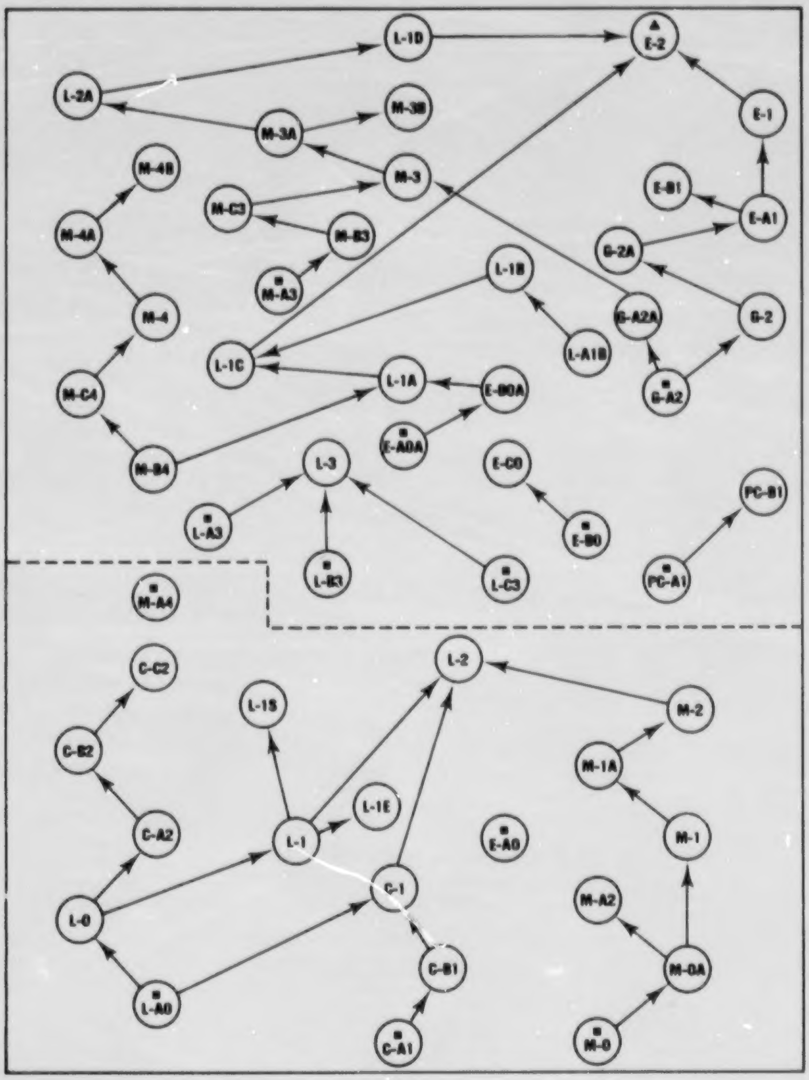
NL Baroid Petroleum Services

A Criterion-Referenced Course

Drilling Fluids Technology, Phase II
erequisite

Name____________________

Instructor Sign-off____________________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M-4A
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L-1C
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L-1S
M-2
C-B2
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C-1
M-A2
L-0
C-B1
M-0A
L-A0
C-A1
M-0

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- * REINFORCEMENT is constant since trainees are encouraged to work together. Those that have satisfactorily completed modules assist other trainees that encounter difficulty. This is excellent reinforcement.

- * CONSISTENCY is not a problem because each trainee receives the same training. When a trainee completes a Phase of training, we know what skills he/she has attained.

- * CONTINUOUS TRAINING SCHEDULE means that there are no classes. As trainees satisfactorily complete on Phase, they move to the next Phase. The only limitation is available space in the training center.

- * HIRING can reflect needs rather than meeting class schedules.

- * LECTURES are used to tie information together and encourage groups participation.

- * COURSE COMPLETION - No one is permitted to complete a course without satisfactory completion of all modules.

Results From Individualized Modular Training

- ** ENTHUSIASM - Trainees are enthusiastic about the training. I was pleasantly surprised that trainees would become so interested in the training that they would return to the training center at night and on weekends to study modules.

- ** CLASS AVERAGE improved 30 points over conventional teaching methods. We used the same tests for both teaching methods and found a 30 point difference in class average.

- ** MOTIVATION is no longer a problem.

- ** UNDERSTANDING - Trainees no longer accept vague explanations. They keep pressing until information is understood.

- ** COOPERATION - Trainees are extremely cooperative.

- ** DIFFICULT SUBJECT MATTER under the conventional method is no longer a problem.

- ** STARTING DATES for courses are no longer required. Trainees are accepted when they meet the prerequisite for the course.

- ** TRAINING TIME to complete a course has been reduced by one third.

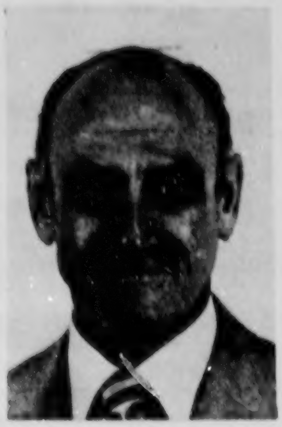
- ** JOB PERFORMANCE - Trainees become productive on the job at least three months earlier.

- ** FACILITY UTILIZATION - The training facility is in constant use. There are no periods of disuse as well experienced with conventional classes. We have almost doubled the training load in the same training space.

I would like to reiterate that I don't consider the individualized modular training method a panacea for all training problems. This technique would be at a disadvantage for highly skilled personnel meeting to exchange ideas.

As a whole, however, the modularized training method has been the most effective method of instruction my company has used in our continuing education efforts for engineers and other personnel. Additionally, I am presently consulting with a major oil company installing my multi-phase, Individualized Modular Training System in that company.

I will now attempt to answer your questions.



FRANK B. DONALSON

MASTERS DEGREE IN INDUSTRIAL ENGINEERING AND INDUSTRIAL PSYCHOLOGY. TRAINING SYSTEMS CONSULTING. OVER 25 YEARS IN DEVELOPING AND CONDUCTING MANAGEMENT, TECHNICAL SALES TRAINING PROGRAMS. THE LAST 5 YEARS MANAGING A MULTI-DIVISIONAL INDIVIDUALIZED TECHNICAL TRAINING PROGRAM FOR A MAJOR COMPANY IN THE PETROLEUM INDUSTRY.

FRANK FOLLOWS THE PHILOSOPHY THAT TO BE EFFECTIVE A COMPANY TRAINING PROGRAM MUST BE CONTINUOUS AND SHOULD BE CONTROLLED AT THE JOB SITE AS WELL AS IN THE CLASSROOM.

BRIDGING THE ACADEMIC-INDUSTRIAL GAP: GE'S ENTRY-LEVEL PROCESS

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Summary

Even though General Electric is well satisfied with the preparation of American engineering college graduates, there is a real gap between academia and the world of work in GE. That gap has always existed and will probably always exist. The gap is, however, understandable and manageable for GE using the entry-level process for professional employees within five years of their baccalaureate degree. The entry-level process gives special attention to work assignments, coaching and supervision, related education, and career planning. The General Electric Edison Engineering Program is described in detail to illustrate specifically how GE helps relatively inexperienced engineering graduates bridge the academic-industrial gap.

About General Electric

GE is a large,diversified, multi-national, technology-based company with about $20 billion sales and 384,000 employees worldwide. About 20 percent of the employees are in the exempt or professional work force. Of the top 15,000 jobs in GE, over 60 percent are held by individuals with four year or higher technical degrees, 20 percent with business or accounting degrees, 10 percent with liberal arts, or other, degrees and 10 percent with less than four-year degrees. 85 percent of the top 500 positions in General Electric are filled with employees who came to GE within five years after their college graduation or equivalent. GE tends to be a "grow-our-own" company and competition for the higher level jobs in the professional and managerial work force is keen. How we manage that work force has major impact on the kind of company GE is and will become. But because GE is a "grow-our-own" company, how professional employees are managed in their early years -- GE's entry level process -- is particularly critical since it is during those early years that work style, standards of performance, personal expectations, and relationships are formulated.

About the Gap

The gap between academia and the world of work in GE is real, has always existed and will probably always exist, and is understandable and manageable.

It may be helpful to compare some of the key elements in the academic environment as perceived by the engineering student with corresponding elements perceived by the engineer in industry. Here are some of the principal differences in these two environments:

Environmental Differences

Element	Academia	Industry
Authority	Professor	Manager
Responsibility	Acquiring Knowledge	Utilizing Knowledge
Problem Solving	Structured	Unstructured
Relationships	Individual	Teamwork
Measure of Success	Grades	Salary

Recognizing these differences and the adjustments that have to be made by every engineer in making a transition from academia to industry emphasizes the importance of having an entry level process that facilitates that transition and provides the foundation for the remainder of a long and productive career.

Let's begin our consideration of that transition with a review of some recent careful studies of today's engineering graduates. We find that today's engineering graduates are better prepared to enter industry than ever before. Their preparation in academic theory continues first-rate and, in fact, appears to be getting better. They come to us with exemplary attitudes and skills. They are serious, and goal-oriented, and are more familiar with engineering systems, tools and techniques than in the "good old days."

Our findings on the excellence of the preparation that today's graduates are being given have been independently confirmed in a recent, even broader, study conducted by The Conference Board. In that study, more than 600 executives of companies employing more than 500 people were asked to rate educational institutions on their ability to prepare their students for the world of work. By nearly ten-to-one, these executives judged four-year colleges of Engineering and Science to be doing particularly well in fulfilling their work-preparation role, ranking these schools higher than any other educational institution.

Coming back to our study of the academic-GE gap. On the negative side -- and it's not a big negative -- our study shows that almost all graduates need improvement in their communication ability, in writing and speaking. Today's entry-level engineers are more comfortable writing computer programs than technical reports. This communication deficiency becomes more critical later on, of course, when we have to evaluate those who want to pursue careers in management.

Another area where our study shows new graduates to be weak, perhaps weaker than they used to be, is in knowing how to apply the theoretical and analytical skills they've learned to the solution of real engineering problems. Often, college students are asked to solve what are essentially theoretical problems in which each element is identified, and given, and for which there is only one right answer. But in the industrial world of engineering, the engineer often doesn't have the problem given to him or her or it may be very ill-defined and ambiguous. The engineer in industry has to identify what the real problem is and recognize there may be several valid solutions that must be evaluated for their relative effectiveness and/or cost-effectiveness.

Here is what a large number of our technical managers in engineering, manufacturing, marketing, and research said they wanted in their young -- five years beyond the bachelor's degree -- professional technical employees. Young technical professionals should have created a desire for and momentum towards functional expertise, whether it be engineering, production, marketing, or whatever the technical areas of work are called. They should have intrinsic high performance standards and high self-esteem. They should be on the way to "knowing their territory;" that is, their product or service, industry, customers or users, professional societies and literature, et cetera. Young technical professionals should be developing and using their ability to know "right answers" and to ask "dumb questions" and to sense, identify, and solve unstructured problems that are probably multi-functional and multi-discipline in nature. They should be able to communicate effectively. They should know and feel that teamwork -- both "micro" and "macro" -- is GE's modus operandi and they should feel comfortable operating in the GE system and culture. Young professionals should feel secure in knowing what GE expects of them and they should expect and be receiving active support and encouragement from their GE colleagues and managers.

By-and-large, we're well satisfied with the graduates that American engineering colleges are preparing for us. They're eager to enter industry and meet its challenges; and they are "turned on" by work that they can become involved in. They themselves place a high value on their first job as an important index of their personal preparation.

Yet with all the skills they've acquired and with their very positive attitudes, these entry-level engineers can invariably be helped to "bridge the gap" between their academic environment and their GE work environment. The help they are offered is GE's entry-level process . . . a specific application and design of the generic professional development process.

The Generic Professional Development Process

Professional development is a complex, lifelong learning process for producing and accumulating the relevant know-how, skills, art, and attributes used by engineers, managers, and other professionals who are the leaders of our society. Professional development is a highly individualized and personal process. The optimum "mix" of know-how, art, skills, and attributes and the process itself depends on the individual, on the nature and position of the individual's activity within the hierarchical structure, and on the nature and size of the organization. It depends on the sponsoring management, the organization environment, and other societal factors. It is subject to the vagaries and vicissitudes of all of life.

The professional development process is always operative whether in varying degrees it is informal or formal, recognized or incognizant. Whether an individual is involved in career development is not the question; it is only whether an individual's career development is purposeful or "willy-nilly." In the career development process an individual moves along a career path during which the individual (hopefully) is continually becoming more effective, but nevertheless is still developing.

With the pertinent societal and organizational environment, career development seems to be influenced primarily by work assignments (perhaps 60 percent at entry level, and even more so during post entry-level); supervision and coaching (about 20 percent at entry level, but decreasing post entry-level) education (15 percent at entry-level, tapering off during post entry-level); career planning (a relatively small but important 3 percent); and other activities (the remaining 2 percent). The assigned percentages are simply the authors' "guesstimates" to illustrate relative impact on career development. The relative percent influence of the five designated career development elements should help prioritize activites for the individual, the manager of the individual, the career development specialist, and the educator.

Work Assignments (60 percent at entry-level, increasing post entry-level)

The developing professional person must have the opportunity to perform real engineering, managerial, or other professional work. By real work, we mean work that if not done by the entry-level professional would have to be done by some other qualified professional. Real professional work is interestingly enough both an end and the principal means for career development. Without real professional work, the individual does not have the opportunity to test his or her capability and interest in doing professional work, nor will the individual have an opportunity to practice the profession (engineering, managing, or whatever).

A specific work assignment can be used creatively as part of the professional development process beyond the "doing." Frequently the nature of the work for a given assignment can be deliberately arranged so as to provide specific on-the-job learning experiences and challenges for the incumbent. New learning opportunities exist when the professional becomes involved with new products, new markets, new technologies, or new functions in the business. New learning opportunities exist in many jobs and are discovered only when the incumbent has the creative insight and the desire to seek out opportunities for learning as part of the job.

Other important learning experiences are available in special work assignments such as task forces, study teams, and committees. Frequently, these special assignments also provide the incumbent with high visibility which can be beneficial to career progress if the job is performed effectively.

Coaching and Supervision (20 percent at entry-level, decreasing post entry-level)

Coaching and supervision can play an important role in charting the course and accelerating an individual's progress along a career path. The ideal boss is one who does not personally do it, but rather teaches and inspires the one who does. That boss is best who turns occasional, rational failure into a learning experience, but anticipates potential or impending disaster and coaches the developing professional to move early enough to take corrective action. That boss is best who sets high standards of performance and demands excellence in the work performed.

Coaching and supervision is needed to develop clear understanding between boss and employee of what is expected, in what time frame, and with what constraints and relationships. An effective boss helps the developing professional define and accept challenging, "stretch" assignments. These kinds of understandings set a basis for trusting relationships, sound performance appraisals, and personal growth.

Coaching and supervision can be most effective when the boss is a role model, not to be emulated in specific detail, but to learn with and from. Coaching and supervision can be most effective when the boss is empathetic rather than simply sympathetic. Coaching and supervision can be most effective when the professional wants to learn!!

Education (15 percent at entry-level, decreasing post entry-level)

Education can help accelerate the professional development of engineers, managers, and other professionals. Here education is used broadly to include combinations of orientation, instruction, off-the-job training, and studying that facilitate the production and accumulation of know-how, skills, art, and attributes.

Education as used here is differentiated from the kind of learning that is inherent in the job itself or that is part of coaching and supervision. Also, it should be emphasized that while education can accelerate career development, it is not a substitute for real engineering, managerial, or other work. Perhaps the most appropriate expectation for education at whatever level it occurs or in whatever mode it is offered, is that it will help the individual "learn how to learn." The individual thus equipped has what is needed to cope with change throughout his or her career.

General Electric regards education as an important mechanism for accelerating professional and managerial career development. In its complementary role to work assignments, supervision and coaching, and career planning, education is a means for helping individual employees develop themselves in order to:

1. accelerate the process of joining-up with the world of work after formal academic training;
2. perform more effectively on current jobs;
3. prepare for new jobs; or
4. gain greater personal satisfaction from their work.

All of General Electric's educational activities are designed to foster the expectation, desire, and habit of continuing education as an important adjunct to work experience in the process of lifelong self-renewal and personal growth.

Career Planning (3 percent)

Career planning helps an individual face up to such tough personal questions as the following:

What do I like to do?

What am I good at?

What don't I do very well?

What would I like to do and why?

What must I do on my present job to perform beyond expectations?

What must I do off-the-job?

Do my family and my boss see me as I see myself?

What will I plan to do?

Career planning should focus primarily on what's next rather than emphasize, as is too often the case, what's the ultimate. A good career plan synthesizes and programs work assignments, education, and other activities to meet an individual's aspirations consistent with his or her capabilities and interests and with an organization's objectives and constraints.

Other Activities (2 percent)

Professional development can also be facilitated outside regular full-time jobs; for example, in community activities, the church, professional societies, hobbies, or recreation. Particularly for younger inexperienced individuals such organizations can frequently provide attractive opportunities to do professional or managerial work before an individual gets a formal leadership or managerial appointment in his or her company or other organization. Community organizations, churches and professional societies are generally seeking help and hence an individual can serve not only his or her self-interests, but society as well. Avocations can also provide important career development experiences.

General Electric's Entry-Level Process

The GE entry-level process -- a specific application of the previously described professional development process -- includes by our definition all professional employees within five years of their baccalaureate degree or, for a small percentage of the employees, those with equivalent preparation and experience. The entry-level process has four primary elements as shown on Chart I.

CHART I

CHARACTERISTICS OF GE'S ENTRY LEVEL PROCESS ALONG DIFFERENT CAREER PATHS

	WORK ASSIGNMENTS 60%	COACHING SUPERVISION 20%	RELATED EDUCATION 15%	CAREER PLANNING 3%
Direct Placement	One job	One manager	Available	Individual
Component Programs	Several jobs in one business	Several managers in one business	Encouraged or required	Individual plus program administrator
Company Programs	Several jobs in several businesses	Several managers in several businesses	Strongly encouraged or required	Individual plus several program administrators

Each of these elements will affect the individual differently depending on which of the three principal career paths he or she may select:

- Direct Placement
- Component Programs
- Company Programs

Direct Placement serves as an important entry level path for those individuals who know quite precisely the job they want. They feel no need to test the validity of their preconceived work interests by exploring other businesses, products, functions or locations. During their assignment, attention is given to assuring that the work is real, challenging and consistent with the interests and experience of the employee. The employee's manager has responsibility for coaching and supervision. Generally job-related education will be available at the location with courses often given on company time. Education is usually available at nearby universities with tuition being paid by the company. Career planning is largely dependent on individual initiative although help is frequently available from the manager or other professionals at the request of the individual.

Component Programs are for individuals who know the business where they want to work but want to have experiences in more than one function or more than one location before making a decision on a permanent assignment. On Component programs they will be given several assignments working for different managers. These programs offer participants the opportunity to "check out" different interests and capabilities and to experience the coaching and supervision of different managers. Job related education is an important aspect of these entry-level programs. Career planning is provided by a Program Administrator who tries to match the capabilities and interests of the people on the program with the work and the managers providing the assignments to give the individual a good start towards his or her chosen career.

Company Programs are operated at the Corporate level for engineers who know what Company they want to work for but feel they need a variety of assignments, perhaps in different businesses or functions or locations before accepting a permanent position. As in the two other career paths, attention is given to challenging work assignments but Company Programs will tend to provide a greater variety of experiences. On these programs practically everyone is involved in additional job-related education that usually includes both Company and University education. Various Program Administrators and an overall corporate program manager help the participants during the entry-level process. Examples of these Company Programs are the Manufacturing Management Program and the Edison Engineering Program. Let's look at the latter one in more detail.

The General Electric Edison Engineering Program

The General Electric Edison Engineering Program is one of the General Electric Programs for Engineers and Scientists. Only outstanding engineering and science graduates are chosen for this program. Program participants are prepared for future technical leadership in the Company in a carefully designed professional development experience including challenging work assignments, careful supervision and coaching, applied engineering problem-solving studies, graduate-study opportunities and help in career planning. Through this advanced training, Edison Engineering Program members experience a wide spectrum of technical work that may include producing new and improved products or developing and applying processes, systems and state-of-the-art technologies. The program has been created to add breadth and depth to their technical and business understanding while affording opportunities to develop their capabilities for performing high-level engineering and scientific work. They learn about their profession from experienced engineers and discover how various jobs relate to a total business.

Work Assignments

The assignment period usually covers two years but this varies according to a participant's interests and progress. All work assignments encourage development of technical skills and are designed as far as possible to meet individual needs and interests. Exposure to diverse technologies, people and functions assists program members in determining their work preferences, and they are urged to use this period for personal development.

Generally each year is divided into two assignments which may be of different duration. As much variety is given in work experience as possible. Assignments may include Advanced Development, Product Design, System Engineering, Laboratories, Reliability and Quality Control, Manufacturing Engineering and Application Engineering.

The Program has been designed for maximum flexibility. It is possible to go "off rotation" at any point in the one-to-three year period, when a participant has found a position within GE that matches his or her skills and interests.

Supervision and Coaching

Regardless of where participants begin their careers, they work with people who are highly respected in their specialties, and have enthusiasm to ease the transition for new employees from school to the GE work environment. An Assignment Manager provides work assignments and guidance and evaluates each program member's performance. A local Program Administrator coordinates assignments within the business location, offers career counseling and supervises the program's content. The Corporate Program Manager is responsible for the overall conduct of the program and monitors the progress of members company-wide.

Participants are treated as professionals within each work environment. They are offered the same opportunities as the permanent staff and share both responsibilities to meet commitments and credit for work well done. Daily contacts with the Assignment Manager are informal, but mid-assignment the manager and program member meet formally to discuss the nature of the assignment, the participant's progress and goals and remaining steps to completing a successful, meaningful work experience. This interim focus is one of numerous opportunities for program members to calibrate their career progress and growth.

The Advanced Course in Engineering

To develop professional engineers, GE stresses a combination of advanced study and practical experience. Engineering leadership requires not only comprehension of advanced technical problems but also experience in their practical application to engineering development and design. This is an important element in bridging the gap. The General Electric Advanced Course in Engineering was originally established more than fifty years ago to sharpen engineers' problem-solving capabilities in an industrial environment. The objective of the Advanced Course is to increase graduates' capabilities to analyze and evaluate the technical and economic significance of engineering problems, to select the best approaches to their solution, to effectively apply principles of physics, mathematics and engineering and to present conclusions and recommend action clearly and concisely. Course formats include lectures given each week by engineers and scientists supplemented by weekly assignments of actual applied-engineering problems. Participants may attend classes during normal working hours, and GE supplies the required texts. Home work assignments are very demanding. Members learn to schedule time by completing work within allotted periods.

The Advanced Course is a three-year program of three courses designated A, B and C. While Edison Engineering Program members are required to participate in the A Course portion of the Advanced Course during their first year on the program, other qualified individuals can and do take the course. The required A Course -- building block of the General Electric Edison Engineering Program -- is an interdisciplinary industrially-oriented engineering problem-solving course that teaches members to approach a large problem, analyze it and reduce it to its components, establish and solve a mathematical model and interpret and report results orally as well as in formal written engineering reports. The A Course is designed to provide exposure to a broad range of engieering disciplines. Problems are selected from areas such as mechanics, electricity, thermodynamics, fluid dynamics, heat transfer, elasticity and control systems. Mathematical techniques including integral transforms, linear algebra, probability fundamentals and computational techniques may also be covered.

Graduate Study

Once the A Course has been completed, program participants are encouraged to continue with the B and C Courses which are in depth courses designed to bring participants to the leading edge of a particular technology. These additional portions of the Advanced Course B and C, are optional for Edison Engineering Program members. They vary in format and subject content since they are conducted by a variety of GE businesses. Another option is to enroll in graduate-level university courses nearby, working towards a Master's degree in the chosen engineering discipline. Advanced education courses at local colleges or universities are tuition-paid. Engineers holding graduate degrees may take additional tuition-refunded university courses or General Electric courses. Educational opportunities and tuition refunds continue to be available to program members and to all engineers and scientists throughout their GE careers.

Career Planning

Program members also participate in systematic, analytical career planning that emphasizes methods to establish and realize career goals. Personal preferences and demonstrated performance are taken into account. During the first month of each assignment the participant and Assignment Manager develop a written understanding of job responsibilities for later use in the performance appraisal.

At the assignment's conclusion, the manager completes an evaluation of performance and career growth and provides advice on career direction. At the same time, each program member is asked to give a frank evaluation of the assignment, its challenges and impact on career growth. These evaluations are the basis for career discussions with the Assignment Manager and the local Program Administrator.

This program is designed to provide a suitable vehicle for members and participating business units to develop and match common interests for post-program placement. The graduating member is well prepared for engineering work, with a variety of work experiences, coaching and supervision from several different managers, education directly related to engineering work and career counseling by both managers and program administrators. Since participants are carefully selected from colleges and universities and accept increasing responsibilities while augmenting their skills with important course work, they are in high demand to fill positions in General Electric.

Summing Up

- The Academic-Industrial gap is a very important and often difficult step in a professional career.
- The transition can be facilitated by attention to:
  - Work Assignments
  - Coaching and Supervision
  - Related Education
  - Career Planning
- The individual remains primarily responsible for his or her career.
- Variety in the Entry Level process permits most individuals to make a good career beginning.

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CONTINUING EDUCATION IN AGRICULTURAL PROGRAMS: TRAINING FOR THE AGRICULTURAL POPULATION OF MEXICO

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"CONTINUING EDUCATION IN AGRICULTURAL PROGRAMS: TRAINING FOR THE AGRICULTURAL POPULATION OF MEXICO"

I.- INTRODUCTION

In recent times education has become one of the basic concerns of countries like ours that are striving to find valid formulas to rise beyond their present level of development.

A country's development embraces all aspects of man's life and being, as it is a process directed to the creation of the necessary conditions for human fulfillment. An indispensable condition for this process to take place is a great capacity for change on the part of society's members.

Nations that can provide education and thus guarantee for the majority of their people the acquisition of the necessary skills to transform backward conditions into conditions for [illegible] can attain a more advanced stage of development in less time. One can therefore conclude that the capacity for learning is vital for development, as is education.

Education is understood as the political, economic and social process through which changes in a society are promoted and directed, and integral harmonious actualization of human beings is furthered. At the same time, it is the link that binds culture to social structure. Thus, education is conceived as an instrument of national policy - particularly in developing countries, where it requires more careful and technical management.

On the premise that Government policies in Mexico are addressed to the overall development of the country, rural education, and especially training for farmers, is one of the basic tooks for their implementation. In this paper an attempt is made to bring together a number of ideas and concepts derived from personal experience, presenting a picture of the mechanisms utilized and the results obtained by agricultural training in Mexico for the rural population, supplemented by training of technicians, engineers and agronomy post-graduates.

In preparing this paper valuable opinions, information and material were obtained from technicians of the Ministry of Agriculture and Water Resources, the Ministry of Trade, the National Basic Commodities Corporation (CONASUPO), the National Agrarian Education Institute of the Ministry of Agrarian Reform and the Chapingo Post-Graduate Program.

II.- FRAME OF REFERENCE

2.1 Generalities

For development to occur in traditionally backward nations a better balance and integration of urban and rural growth is necessary. As a greater number of priority projects in the 50s and 60s focussed on modernization and development of the urban sector it has been even more difficult and complicated to improve economic and social opportunities for rural areas.

As agricultural development is the main component of any succesful program for rural areas, simply because 80% of the Third World's population is engaged directly or indirectly in agricultural activities, it should be viewed within a broader perspective.

This broader view should be of transforming economic, social and institutional structures, as well as the structure of relations and processes in rural areas. Rural development goals cannot be restricted solely to agricultural and economic growth, but should be seen more in terms of a balanced economic and social advancement, with emphasis on equitable distribution for the rapid achievement of higher levels of wellbeing.

Among these ambitious goals should be included the creation of more job opportunities, access to productive land, a more equitable distribution of rural income, more extensive care for the improvement of health, nutrition and housing, and lastly greater access to education - both formal and informal for children and adults; which could be directly relevant to the needs and aspirations of the people who live in the country.

One might question whether the educational systems currently in operation in developing countries have contributed to rural development. We do not believe their contribution has been entirely satisfactory, as they have been overly influenced by systems that have been succesful in quite different circumstances for industrialized countries.

The most advisable priority at this time is to pay special attention to an increasingly large proportion of students in rural areas, especially those who very likely will live out their lives working in the same place. Better groups are required o people skilled in doing well in such an environment young people and children out of school, women and small farmers to whom the doors of organized formal or informal education are closed.

Efforts should the be made for education in the rural areas of underdeveloped countries to make a real contribution towards raising the standard of living of agricultural communities.

2.2 Some Background on Agriculture in Mexico

From 1940 to 1960 agricultural production in Mexico grew at rates of more than 50% a year, while population increased at 2.9%. Internal demand was met, there were exportable surpluses and a relative stability of prices could be maintained.

However, starting in 1964, the agricultural output began to increase at barely 2.4%, less than the rate of population growth. The result was a heavy migration of unemployed labor to urban areas and a severe decapitalization of agriculture, from which substantial resources were - transferred to industry and business. In short, there was a severe agricultural recession, the impact of which was felt throughout the entire economy.

This recession resulted from an imbalanced distribution of income and the excessive concentration of wealth, accentuating the dual nature of agriculture, expressed in the coexistence of a very large traditional agricultural population of low productivity, and a slowly growing modern sector that is encountering increasingly greater difficulties to keep up its productivity level.

Strictly speaking, the causes of this recession were the inadequacy of public and private investment, and the lack of a long term agricultural policy and plans. We are still suffering its effects: a generalized price increase and the consequent actual reduction of fixed income. To overcome this situation investment and employment are being increased. The rural population has started to take part in making decisions that will affect it, by means of continuing training to combine their participation with guidance, and so further the achievement of social and production objectives.

III.- TRAINING FOR THE AGRICULTURAL POPULATION

3.1 Concepts, Objectives and Characteristics

As one of the national goals is to increase the production of foodstuffs and other agricultural output, a primary function of the government is to create the favorable economic and social conditions for this purpose by means of various programs to strengthen the development infrastructure of this sector.

In this context, training is envisioned as a basic tool to promote the rural developmentprocess, in accordance with this premise of the people's participation to support agricultural programs designed for them.

Agricultural training programs use a procedure in keeping with the factors of the agricultural sector that takes into consideration past experience. They have been structured on the conviction that it is the core of people themselves who should decide upon and undertake basic actions for development, according to their true needs, aspirations and resources, with the support and coordinated aid of the Government.

According to this concept, agricultural training and the process that results from its application, attempt to create conditions of social willingness that will indicate the time and mode for institutional intervention. In this endeavour, the people's disposition or will would guarantee the social and economic utilization, yield and recovery of the various investments.

The main objective of training for the rural population is to aid in the creation of a productive agrarian social structure by making available to the people the necessary knowledge and skills so that they can participate in enterprises they themselves undertake, reclaiming their historic initiative and generating the attitudes and skills required for them to know what their living conditions are, and based on that knowledge, to change them systematically and continuously, by organization of productive labor.

Interconnected coordinated training programs of the various official agencies - are the operational tool of all education activities carried on by the Government in rural areas. Their objectives, listed below, give an idea of their characteristics.

The National Agricultural Development Program for Rain-Fed Areas (PRONDAAT), under the coordination of the Chapingo Post-Graduate School has the following objectives:

For the short term: "To supplement local production technology for the more important crops with know-how that will raise the productivity of land, labor and capital, if the utilization of these three basic resources is intensified."

In the long term: "To develop agricultural systems in keeping with regional needs, and with the various plans for the different geographical areas of the country".

The Conasupo Center Agricultural Training Program (CECONCA) has as its main objective: "To train rural workers, teaching specific land and animal husbandry techniques with a political orientation to hel achieve more efficient marketing of basic commodities and better income for rural society, through its aware and organized participation in the agricultural production process and the defense of tis class rights".

The National Agrarian Training Program, entrusted to the National Agrarian Training Institute plans to attain its objectives by working towards three specific goals:

That the rural population regain their historic initiative to effectively undertake, organize, manage and perform actions required for agricultural production and development.

To promote responsible, aware and organized participation of the people in the national democratic popular alliance for production.

To develop in the rural population the knowledge and skills required for optimum utilization of the resources available to them, so they may take part in the - beneficial transformation of conditions by means of a proper organization of productive rural labor.

Rural training in Mexico, in pursuance of the above objectives, is considered to have the following characteristics:

It is dynamic, because it fosters and accelerates positive changes in the rural population, adapting and guaranteeing its permanent, self-sustaining applicability.

It is integral, because it covers all aspects of knowledge and skill required to obtain, preserve, develop and make optimum use of available resources, within the context of the internal and external relations of agrarian nuclei, understanding the latter as the basic socieconomic production units.

It is redeeming, because it respects the true values of country people, and seeks to reestablish and strengthen them, adapting them to the country's present factual conditions.

It is an organ for communication because it favors the generation and transmission of knowledge by and among the rural population.

It is a promotion activity, because it fosters the people's initiative to take part in their evolutionary process by organizing rural labor.

3.2 General Operation Outline

Strategies and methodologies are applied for agricultural training, which adjusted to the particular characteristics of each agrarian group, provide the necessary training for country people to participate in their own process of evolution by the systematic application of knowledge, and to perform the specific actions this entails by promoting and giving technical support to this process in all rural nuclei.

The methodological concept of rural training is based on the consideration that the people's initiative to undertake actions arises from an exercise of the transformation process, which in turn emerges from a knowledge of reality. This requires the right skills and attitudes, and the furnishing of these skills and attitudes is the basic objective of all training actions.

An outcome of this process are the various alternatives and specific action programs for development, as well as the demands for specific skills, knowledge and attitudes to implement them. These matters are covered by rural training, particularly in areas relative to organization, management, programming and production.

If a rural population nucleus is aware of the facts and of the actions required to transform them, a necessary result will be that it joins forces with other neighboring nuclew with common problems, so that they can undertake together the actions needed for their solutions.

Training for the rural population of Mexico deals with two basic areas: training for productive organization and training to optimize production.

The first is done through the National Agrarian Training Program, which carries out an articulated systematic training process with a methodological model which focuses contraining cadres who will them do agrarian training. Their target population is the field offices of other institutions which play an active role in rural development.

One the human resources who will carry this training effort to the field are prepared, they go to an agrarian nucleus where they share the lives of the people. Trainers and trainees together diagnose the situation and develop a strategy for its solution; when considering the strategy's feasibility they define and call for the action of other institutions who will assist them by providing technical and economic support until the project is operating normally.

As regards training for production optimization, this is done through the National Program for Rural Development in Rainfed Areas and through CECONCA.

The Chapingo Post-Graduate School, which coordinates the Rainfed Areas Development Program, makes available to people in those areas, through their training efforts, the findings of tis agricultural research to apply it to various representative places of the region in which it operates, so that particular weather and geographical features will not adversely alter results.

The training program methodology includes:
- Identification of local technology components with the greatest marginal production, as well as of new possibilities, while developing more knowledge about short term ecological restrictions.

- Identification of production technology alternatives, by approximations which will result from a trade-off among the three factors below:

a) degree of knowledge of a given production ratio;
b) marginal productivity of the factor involved,
c) acceptable degree of risk of proposing to farmers the wrong alternative.

- Learning by researchers of some of the key production components used by farmers.

This traditional knowledge together with the skills and resources of modern disciplines are the ingredients to be used in improving technology. As agronomy research is a fundamental part of the program's methodology to improve production; generation of technology itself is just an intermediate step and this is why the procedure of succesive technical approximations has been employed.

Regional teams are used in this program, composed of technicians who carry out various activities and who work for different institutions, but who, because of the program's general policies, try to work together according to existing local conditions. The four basic areas covered by technicians on the teams are: agricultural research, socioeconomic evaluation, agricultural dissemination and coordination.

The program's implementation by regional teams is particularly beneficial because it provides for continuous critiques and questioning of all team members. Moreover, as they are in permanent touch with the farmers, the latter, who are familiar with local technological problems, inform the researchers so they can find a solution.

The Conasupo Center Agricultural Training Program operates on the basis of the specific characteristics of the population nuclei in the Centers, by means of dynamic, productive instruction, in which the instructor is simply a more experienced peer who aids in the learning process, but this process is induced or generated by the trainee.

Training programs operate on the basis of short intensive courses, which are later supplemented and reinforced with reading material.

Every course covers two areas: teaching of productive utilization of specific agricultural technicques and the awareness that these should be used to serve the community.

Audiovisual aids are used in teaching for greater ease of understanding and learning. However, the students are encouraged to write their notes in their own language and according to their own experience, so that they can use their notes as a reference tool.

The system used for academic sessions is not so much tat of simple lectures but rather an adaptation of socialized dynamic study, based on giving all participants a chance to make use of their knowledge and acquired experience by considering other points of view, clarifying dobuts and voicing their interests and concerns in the work group. That is in - this type of education students generate their own learning.

Faced with the growing demands of rural sectors for training programs and the impossibility of setting up more centers, two new programs were devised that make it possible, with minimal resources, to take external massive training to the countryside; training by People's Instructors who go to rural communities and implement the work program for each region, using Correspondence Courses.

The above shows, that given the unique characteristics of this kind of training, there is no duplication of functions of private and public educational institutions.

IV.- A PRELIMINARY EVALUATION

The implementation of rural training programs in Mexico has confirmed that groups of agricultural workers with awareness, responsibility and organization, participate in and undertake production activities to work towards their development.

Results attained to date objectively confirm that the organizational process, when it arises from the basic sectors themselves and is channeled by able leaders, helps the State to achieve its objectives in the area of social support for production, as opposed to past practices which, without regard to the people's own interests or considerations, attempted to convince them or impose organizational forms developed by others and quite foreign to them.

It can also be seen that when the people themselves take part in programs and objectives of public agencies working in the countryside they facilitate and enrich such programs and vecome a tool for intersectorial coordination and for the support of Government action in the rural sector.

However, within the context of Government agrarian training policies, it must be emphasized that rual populations need training to participate more actively and effectively in economic and political decisions, and in society in general. Training for the new increase of agricultural production by teaching the indispensable technical know-how does not ensure full utilization of this sector's creative potential.

Even so, it is satisfactory to see that real efforts are now being made in Mexico to actively integrate to the production process and rapid development of society these large groups of the population that were traditionally marginal.

The basic contribution of the training programs' implementation has been a working method that has enabled groups of rural workers and other sectors of society by learning about their own reality so that they can transform it.

V.- CONCLUSIONS

The experience gained to date with Agrarian Training Programs in most of our countries has been in the framework of a rural society totally outside the development process of urban areas.

This separation from decision making, and from the efforts and fruits of development - in the political, economic and social spheres - is in most cases a reflection of a modern culture superimposed on a traditional background, cancelling all its potential.

It is therefore necessary to carry out a comprehensive process of reclamation, to place in its true dimensions the importance of the values of rural society, to achieve the full development of society as a whole.

Thus, it is important to carry on with sustained training activities, which, in keeping with the particular circumnstances of each country or region, and more importantly, of each rural nucleus, will favor the rebirth of these people's initiative to participate in all activities directed to the improvement of social well-being.

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En el Gobierno Federal ha sido Gerente General de Panificadora Conasupo, S.A. (1971), de Bodegas Rurales Conasupo (1971-76) y de Almacenes Nacionales de Depósito (1975-76). Director Fundador de los Centros Conasupo de Capacitación Campesina (1971). Director General de la Industria de Transformación Paraestatal en la Secretaría de Patrimonio y Fomento Industrial (1977). Actualmente Director General de Delegaciones Federales de la Secretaría de Comercio.

De sus publicaciones destacan las de: "Características Momento-Curvatura de Secciones de Concreto" (110P) Ed. UNAM., y "Aplicaciones de la Estática" (350 P) 1972.Ed.Limusa, S.A., 2a. Edición 1976.

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FACTS AND FIGURES ON CONTINUING EDUCATION FOR SIEMENS AG ENGINEERS

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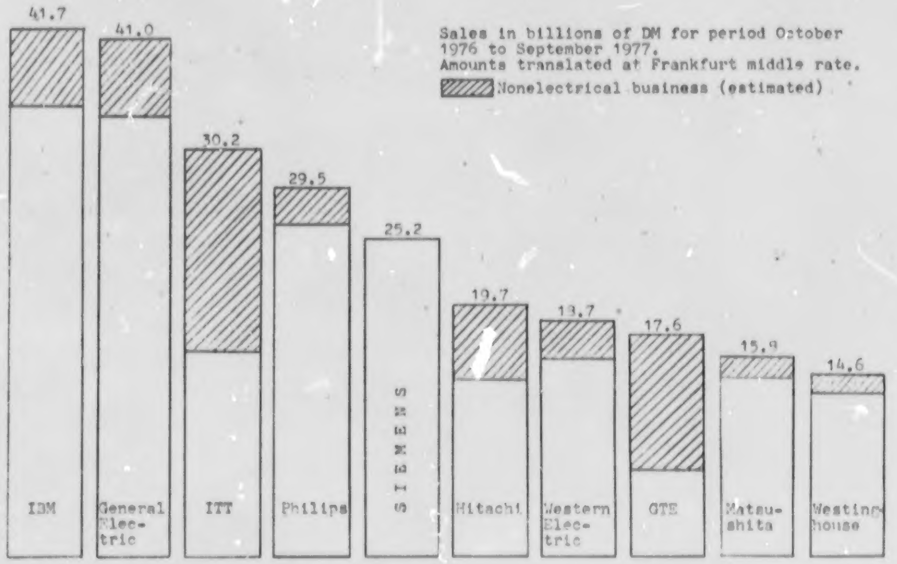
Background (organizational environment)

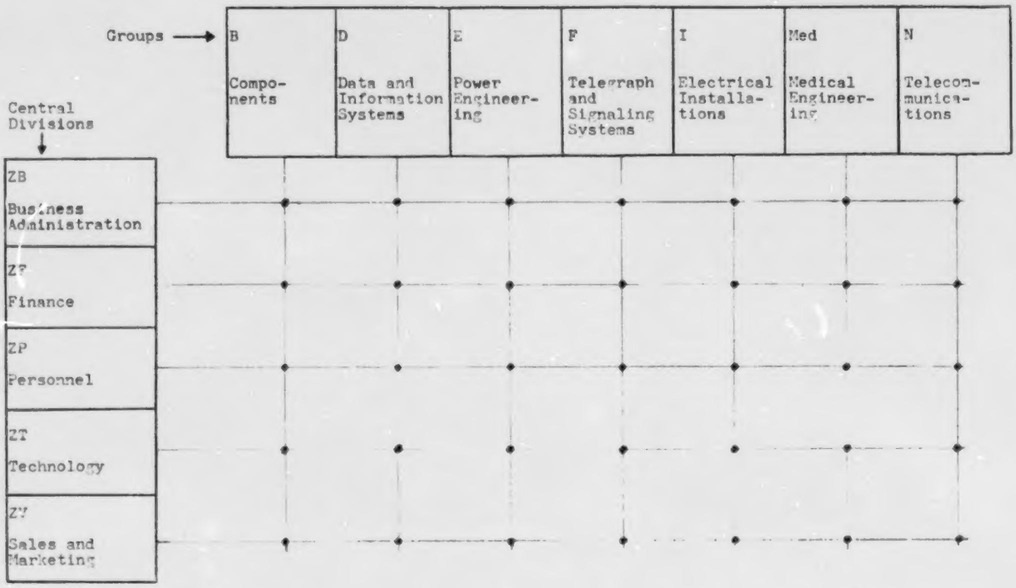
Siemens AG is an electrical engineering company engaged in research, development, manufacture and sales of electrical products and systems. Founded in 1847 and having survived the upheavals of two world wars, the company is now the 5th largest electrical engineering company in the world (Fig. 1). The value of the orders received world wide in the last fiscal year was DM 25.9 billion, while the turnover reached DM 25.2 billion.



THE 10 LARGEST ELECTRICAL COMPANIES

Fig. 1

Siemens AG consists of 7 Groups and 5 Central Divisions (Fig. 2). The products of the various groups cover the entire field of electrical engineering, with power ratings ranging from 10^{-16} W in equipment designed for receiving coded data from weather buoys, up to 10^{9} W in power station technology.


Groups
B
Components
D
Data and Information Systems
E
Power Engineering
F
Telegraph and Signaling Systems
I
Electrical Installations
Med
Medical Engineering
N
Telecommunications
Central Divisions
ZB
Business Administration
ZF
Finance
ZP
Personnel
ZT
Technology
ZV
Sales and Marketing

ORGANIZATIONAL STRUCTURE OF SIEMENS AG

Fig.2

Sales are handled through 130 regional sales offices and branch offices in Germany, and through Siemens companies and representatives in approx. 400 cities abroad.

The Power Engineering and Telecommunications Groups and the regional sales offices account for the greater part of the total number of employees.

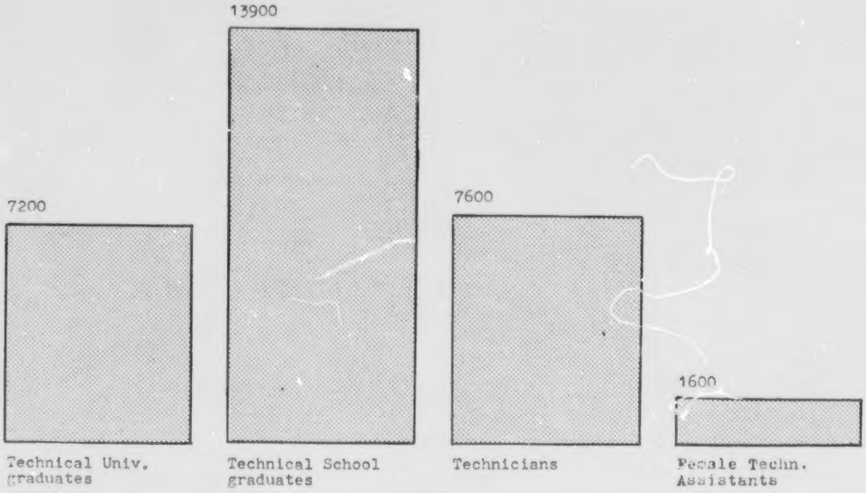
Education at Siemens AG comprises two sectors:

* The in-house vocational training of workers, apprentices and technical assistants (female) two to three year courses.
* The continuing education of workers and the technical and commercial staffs.

Our activities in the field of continuing education, in particular for engineers and technicians, will be presented below.

Continuing education programs have to be developed for some 21,000 engineers and scientists as well as for 7,600 technicians (Fig. 3), and also for about 8,000 engineers working outside of Germany. The percentage figures for the fields in which the engineers and scientists were originally trained are as follows:

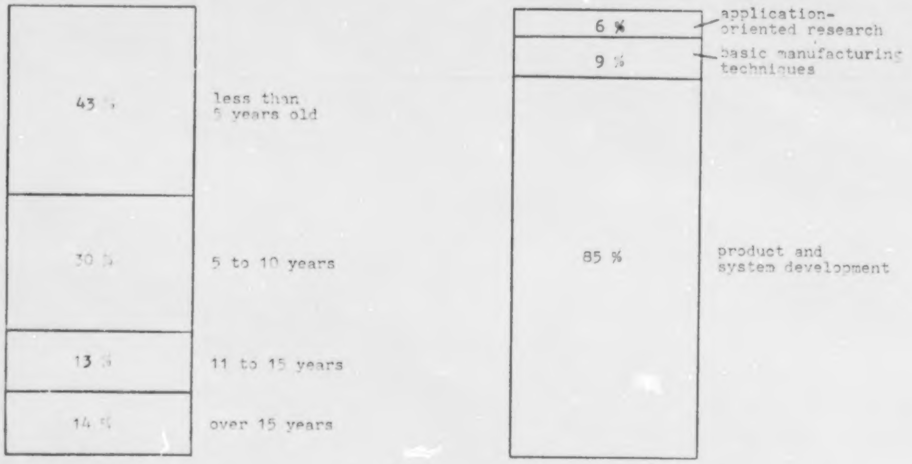
65 %	electrical engineering
18 %	mechanical engineering
6 %	physics
11 %	civil engineering and architecture, mining and metallurgy, chemistry, computer sciences, mathematics, industrial engineering and others.



ENGINEERS AND TECHNICIANS AT SIEMENS

Fig.3

The importance of continuing education for these engineers and scientists can be seen in Fig. 4: products introduced less than 10 years ago accounted for 73 % of sales in the 1976/77 fiscal year, and products on the market for less than 5 years made up 43 %. Accordingly, 85 % of our total expenditure of DM 1.9 billion for research and development is spent on product and systems development. This major change in our range of products within a few years' time underscores the importance of continuing education, which calls for a very high degree of flexibility to meet constantly changing requirements.



Product breakdown of 1976/77 sales

Research and Development expenditures 1976/77: DM 1,9 billion (over 8 % of sales)

RESEARCH AND DEVELOPMENT AT SIEMENS

Fig.4

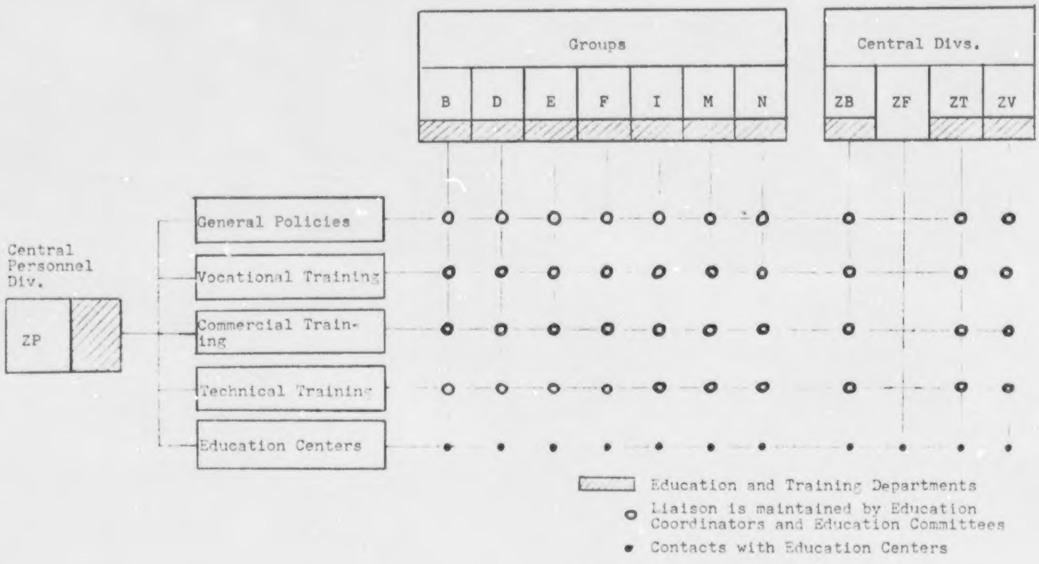
Siemens concept of in-company continuing education

As early as 1968, the Chairman of the Board highlighted the objectives of continuing education with the following comments:

"New fields of engineering are a major factor determining the further development of our company; they are being added in ever quicker succession to our business where they quickly gain importance in quantitative terms as well. Much the same can be said for new organizational forms and means, for modern methods of the decision-making process (such as on opening up new markets), for new forms of cooperation, within the company and with other companies, information flow etc. These trends have become particularly apparent in the last decade and have had the effect of frequently out-dating the knowledge that many employees acquired during their training (apprenticeship, university degree, practical experience), making it difficult for them to meet both present and certainly future requirements ..... We therefore intend to place more emphasis than in the past on the training and continuing education of our employees. One of the major objectives in doing so is to offer all employees better opportunities to develop their skills and capabilities for their own career advancement ....".

As every other company activity, in-company education is subject to the requirements of economical operation. This means that the task of stepping up educational activities even more is one that cannot be solved merely by increasing the number of courses offered. Our efforts are directed primarily at raising the effectiveness of our educational work by systematic planning and implementation of the training programs.

The re-organization of the company in 1969 involved a re-organization of responsibilities for continuing education as well (Fig. 5). Since then, each Group and Central Division, with the exception of the Central Finance Division, is also responsible for educational matters, in addition to its regular responsibilities:


Groups
B
D
E
F
I
M
N
Central Divs.
ZB
ZF
ZT
ZV
Central Personnel Div.
ZP
General Policies
Vocational Training
Commercial Training
Technical Training
Education Centers
▨ Education and Training Departments
○ Liaison is maintained by Education Coordinators and Education Committees
● Contacts with Education Centers

EDUCATION AND TRAINING AT SIEMENS

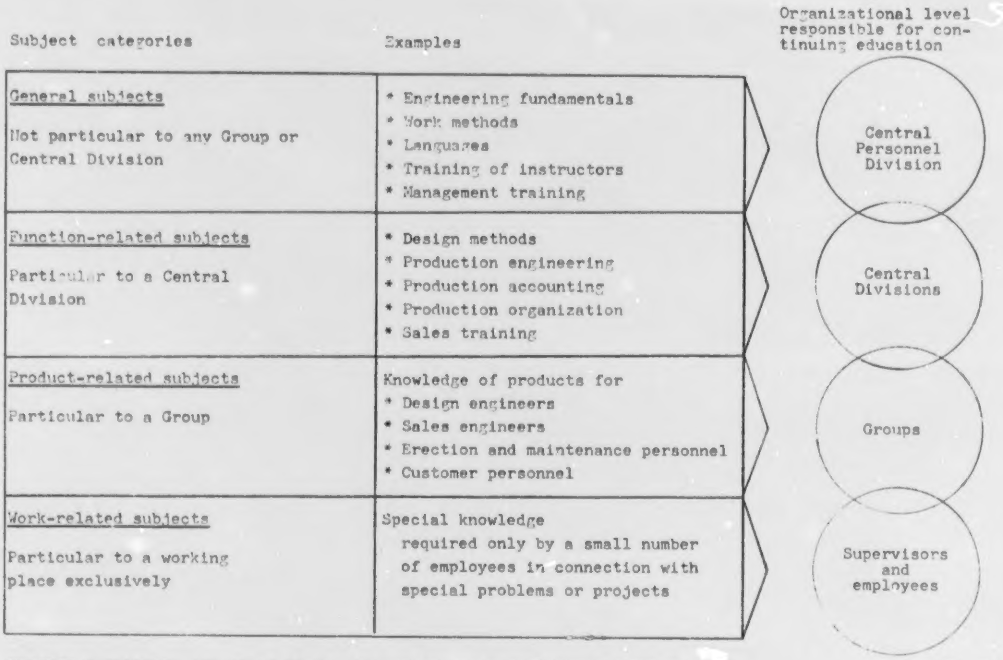
Fig.5

* The Central Personnel Division is responsible for
  - determining the basic policies for training and continuing education, both for commercial and technical personnel, as well as for management training
  - coordinating all training activities
  - developing and implementing training programs for general subjects on a corporate level at the education centers.
* The Groups are responsible for developing and implementing educational programs for product-related subjects. "Product training" carried out by the Groups at their respective locations constitutes the largest sector in continuing engineering education.

The flow of information from the Central Personnel Division to the Groups and vice versa is maintained by specially appointed education advisers. This organizational arrangement is intended to ensure that a maximum of continuing-education needs are recognized and efficiently met by a meaningful division of responsibilities and mutual cooperation.

When this organizational set-up came into being in 1969, a survey involving questionnaires and interviews of employees and senior staff was conducted in order to analyse their educational needs. This analysis resulted in the four subject categories shown in Fig. 6.

Numerous training measures in each of these categories require regular updating. In the case of product-related knowledge, the new training subjects result directly from progress in engineering and can be fairly quickly selected by consulting the product managers. It is somewhat more of a problem to determine new subjects where knowledge of a general and function-related nature is involved. This is where the Central Divisions' education departments must suggest new courses or offer them on a trial basis.

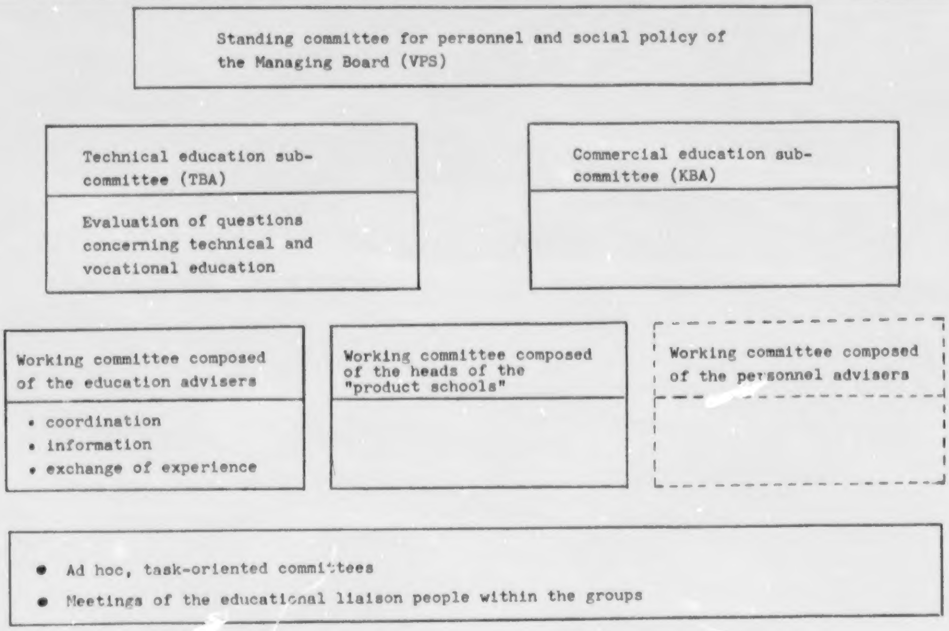


Subject categories	Examples	Organizational level responsible for continuing education
General subjects Not particular to any Group or Central Division	* Engineering fundamentals * Work methods * Languages * Training of instructors * Management training	Central Personnel Division
Function-related subjects Particular to a Central Division	* Design methods * Production engineering * Production accounting * Production organization * Sales training	Central Divisions
Product-related subjects Particular to a Group	Knowledge of products for * Design engineers * Sales engineers * Erection and maintenance personnel * Customer personnel	Groups
Work-related subjects Particular to a working place exclusively	Special knowledge required only by a small number of employees in connection with special problems or projects	Supervisors and employees

SUBJECT CATEGORIES AND AREAS OF RESPONSIBILITY IN CONTINUING EDUCATION

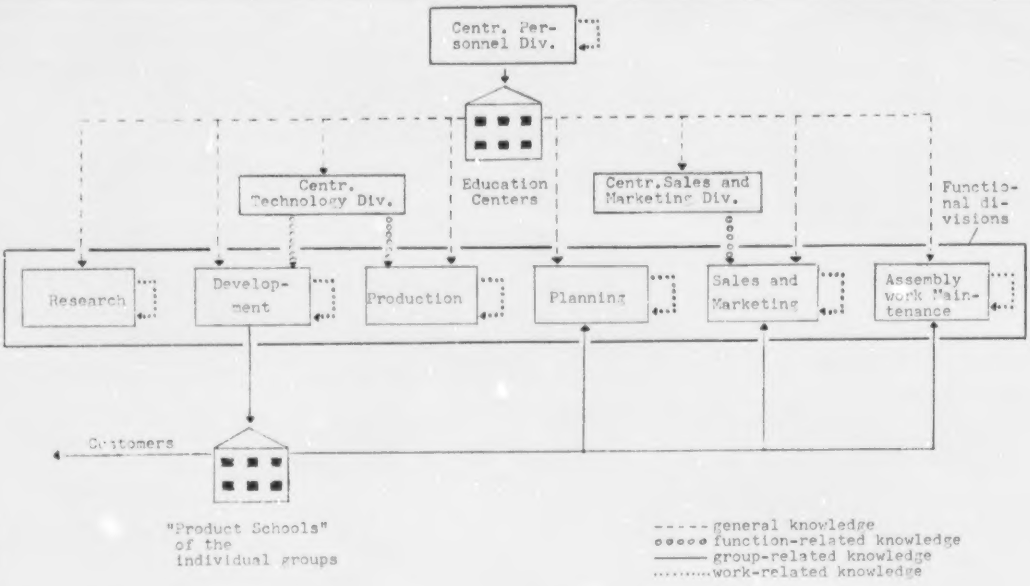
Fig.6

The Central Personnel Division can draw on various committees for advice and implementation of its proposals (Fig. 7).


Standing committee for personnel and social policy of the Managing Board (VPS)
Technical education subcommittee (TBA)
Evaluation of questions concerning technical and vocational education
Commercial education subcommittee (KBA)
Working committee composed of the education advisers
• coordination
• information
• exchange of experience
Working committee composed of the heads of the "product schools"
Working committee composed of the personnel advisers
● Ad hoc, task-oriented committees
● Meetings of the educational liaison people within the groups

EDUCATION COMMITTEES AT SIEMENS Fig.7

All Groups and Central Divisions are represented in these committees, enabling a clear picture of the prevailing views in the company to be obtained. The Groups and Central Divisions assist and complement each other in processing and conveying new knowledge and information coming from the various subject categories (Fig. 8):


Centr. Personnel Div.
Centr. Technology Div.
Education Centers
Centr. Sales and Marketing Div.
Functional divisions
Research
Development
Production
Planning
Sales and Marketing
Assembly work Maintenance
Customers
"Product Schools" of the individual groups
----- general knowledge
ooooo function-related knowledge
—— group-related knowledge
.... work-related knowledge

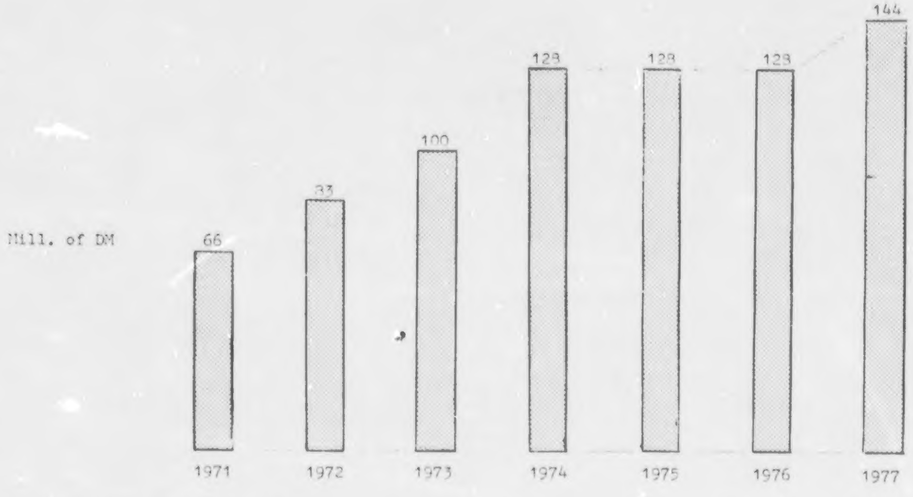
ORGANIZATION OF CONTINUING EDUCATION OF ENGINEERS AND TECHNICIANS Fig.8

- The Central Personnel Division develops courses on engineering fundamentals, work methods, languages, training of instructors etc. These subjects are then taught at the education centres set up in Berlin, Erlangen and Munich, the major locations of the company. Another education centre at Feldafing (Bavaria) has been created for management training.
- The Central Technology Division develops and conducts courses concerned with process and production engineering, quality-related matters, work analyses, planning methods etc. for the Development and Production personnel.
- The Central Sales and Marketing Division is responsible for all subjects involving sales training for the Sales and Marketing personnel.
- The "Schools" of the Groups offer Division- and product-related knowledge for project planning, sales, erection, commissioning and maintenance. These "Schools" are usually situated at the headquarters of the Group and also handle the training of our customers.
- Job-related knowledge has to be organized or conveyed on an individual basis within each section. Training on an individual basis plays a particularly important role in the Research and Development departments. The work of specialists in R and D, being chiefly problem-oriented, does not lend itself to any systematic form of continuing education. Work and work-related stimulant and incentives to maintain the creativity or such specialists must be provided in the form of personal contacts, congresses and symposials.

Continuing education programs are usually announced anually by the training departments. Programs on courses conducted during office hours are sent to the senior staff only. Courses held after office hours are indicated on the bulletin board.

Depending on the subject, a course may last from 4 hours up to 9 months. Most of the courses cover 20 to 30 hours.

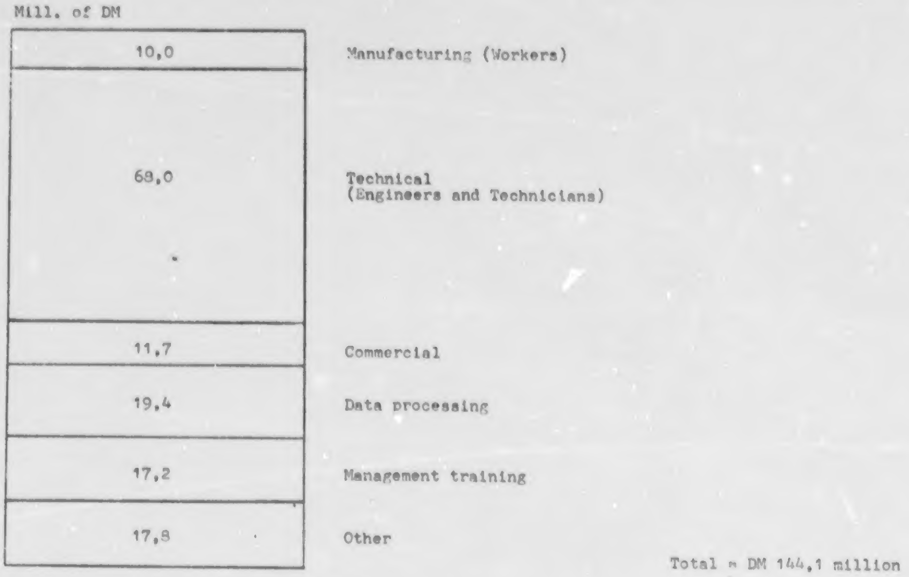
The cost of the employee training program is borne by the company and amounts to DM 1,350,- per employee (doing technical work) annually. This figure includes personnel and material costs, the former accounting for 75 % (20 % for instructors and 55 % for the working time lost by the student employees). The cost figures for continuing education are given in Fig.9,



COSTS OF CONTINUING EDUCATION

Fig.9

and the distribution of costs is shown in Fig. 10.



COSTS OF CONTINUING EDUCATION IN 1976/77

Fig.10

For the most part, our training courses are conducted during office hours. Registration for courses held during office hours is subject to approval of the employee's immediate supervisor. The employee is, of course, free to suggest enrollment for himself in a training course to his immediate supervisor. A real problem in this respect is the fact that some supervisors are not prepared to release their employees from work to the extent necessary. For courses after office hours, any employee meeting the qualifications requirements indicated for each program may enroll directly.

Some 3,000 regular employees of the company double as instructors. An additional 400 instructors are engaged full-time at company "schools". These full-time instructors must make sure that they are always aware of the latest technical developments. The instructors for continuing engineering education are selected primarily from experts within the given fields. Where necessary, the company provides courses on the techniques of instruction for those who teach.

The continuing education programs are evaluated by the instructors from results obtained in study groups and in the final discussions, as well as from questionnaires completed by the education departments after the course. Final examinations to determine the extent to which the participants have learned the material offered are held only in exceptional cases. An important task of supervisors is to make possible and supervise the practical application of what the student has learned. There is no systematic evaluation of the success of our courses, as the necessary outlay, considering the 5,000 individual courses, and 50,000 students per year, would not be warranted by the benefits obtained. In general, the views expressed by the students, instructors and students' supervisors in the ways mentioned above are used as indicators for determining the success of a training program. A detailed check on the success of such a program is only made in exceptional cases.

Because of the size of the company, Siemens can meet nearly all of its own needs in continuing education. Where applicable employees are sent to attend courses outside of the company, or external instructors are engaged.

Public expenditure in the Federal Republic of Germany and Berlin (West) for training and education amounted to a total of DM 58 billion in 1976. Of this amount, DM 1.4 billion went to continuing education.

Expenditure by the private sector of the economy for training and education is estimated at DM 10 to 15 billion for the same period. Continuing education is likely to account for half of this estimate.

In summary, all of the details presented so far on continuing education at Siemens should be viewed in the light of our following training principles:

* In-company training is provided only if no equivalent training is offered outside, which is often the case.

* The initiative for continuing education must come not only from the company but to a major degree from the employees as well.

* Each training program is planned and executed on the basis of a description of the training objective, and is evaluated in terms of its instructional and commercial success.

* The persons primarily responsible for the training of employees are the supervisors.

* The instructors are carefully selected and prepared for their tasks.

* The most effective and most economical training methods and media are used in all of the training programs.

* Expenditure for in-house training is borne by the company.

Dr. Ernst Golling

- Born on 21st October 1919 in Wolnzach
- PhD in Physics at the University of Munich 1951
- With Siemens AG since 1951:
  From 1951 to 1965 in the Research Laboratory in Erlangen, engaged in the field of Solid State Physics, Spectriscopy and Nuclear Magnetic Resonance.

  From 1965 up to now responsible for the Technical Training and the Continuing Engineering Education.
- Since 1970 lecturer for "Special subjects for electrical measurements" at the University of Erlangen.

A CASE STUDY ON A SUCCESSFUL INDUSTRY-UNIVERSITY SOLUTION TO A CONTINUING ENGINEERING EDUCATIONAL PROGRAM

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Introduction and Problem Statement

The Westinghouse Meter Division, an operating business unit of the Westinghouse Electric Corporation, can trace its beginnings to the need for a practical metering device encountered by George Westinghouse in the course of his development of alternating current in the late 19th century. The Meter Division is in Raleigh, North Carolina.

Oliver B. Shallenberger, Chief Electrician of the Westinghouse Company, recognized in 1888 that to measure AC ampere hours was not the final answer to the problem, and that watts must also be measured on inductive or motor loads. Seeing the need for a true energy-measuring device, he developed a new meter and in 1894 Westinghouse began production of the Shallenberger integrating wattmeter.

The invention of the small round-type Westinghouse meter in 1897 to replace the early, large, cumbersome Shallenberger meter was a significant milestone. Although many refinements in accuracy, reliability and load capacity have since been made, this meter included nearly all the fundamental electromechanical design principles found in every AC watthour meter produced up to today.

Now, due to the increase in costs of generating and distributing electricity, U.S. electric utilities and their regulating bodies appear to be on the verge of a major change in rate structure. Time-of-day pricing for electricity is seen as a means of charging each customer in accordance with the cost to serve that customer. A typical new rate structure calls for metering three different rates per day during the week and another rate for the weekend. This is very complex and unacceptable from an economic standpoint using the traditional electromechanical watthour meter and its mechanical register. However, due to the advances in electronic technology, particularly microprocessors, it is now possible to accomplish this without disturbing the reliability of the time-proven watthour meter.

The Meter Division faced a sharp change in technology not unlike the change that has taken place in the watch-making industry. The demands of the marketplace required that the Division begin production of solid state metering devices. This placed severe demands on the engineering staff.

Solid state technology requires new knowledge and skills in engineering, manufacturing and marketing throughout all levels of management, professional and technical personnel. The education, training and experience of Meter Division personnel was primarily geared to skills which support the electromechanical design and manufacture of a meter to measure 60 Hz power with the precision of a fine watch. Many of our engineers were "power option graduates" without the education to think "solid state". Those with electronic backgrounds needed updating on solid state technology.

Recognizing the broad and urgent need, Division management enlisted the support of the Corporate Technical Education Planning activity as part of an ad hoc group to explore the needs and develop a plan to meet the need for the required capabilities.

In this case study, we will discuss the method used to develop a successful continuing engineering educational program for the Meter Divison to meet their new requirement. The method employs techniques to identify needs, set objectives, characterize the intended audience, identify instructional staff requirements, define content and evaluate program effectiveness. The case study illustrates an effective way to enlist university and other education and training resources to achieve specific program objectives.

Division personnel were capable and highly motivated. Relationships between management, professional and non-management employees were excellent. The Division received technology support from our Corporate Research Laboratories and the assignment of a few key experienced solid state electronics managers and professionals. But it was recognized that this was not enough. Some said it was not possible to retrain a staff comprising "60 Hz electromechanical" engineers to deal with the new solid state technology. But this program showed that it could be done. A full cycle of the training program has been completed and portions, as needed, will be repeated.

Program Development

Based on our experience in developing programs, we have found it important to go through the following steps first:

1) Define and articulate needs.
2) Develop statements of objectives.
3) Develop profile of participants.
4) Determine candidate topics (or content).

Only then are we equipped to examine alternative ways of meeting needs, even including the possibility that developing a course will not meet the need. Only then are we able to design the program and decide what combination of university-based, in-house, professional society, commercially available or other programs will best fit. We have found it a mistake to discuss other issues, such as course content, length, instructors and delivery modes before going through these steps.

The process takes time and effort at the beginning, but we are convinced the results are worth the investment in terms of subsequent program effectiveness.

Our program development was based on two assumptions:

1) That a program will be more responsive to the organization's and the learner's needs if representatives of the potential program participants help set the objectives and develop the program, and
2) That where there is involvement in the program design, there is commitment to the program's success.

Malcolm Knowles[1] in his description of characteristics of the adult learner, says that the adult recognizes on-the-job needs (evaluates what he needs to know and what he needs to be able to do), is results-oriented, sees himself as capable of self-direction and defines himself in terms of his experience.

We have built on these characteristics in the successful development of in-house[2] and joint university-industry continuing engineering studies (non-credit) programs,[3] including the Meter Division Program.

The Development Process

From the very beginning of the program development process, we asked our key Meter Division engineering managers and professionals to participate in the program development. Participating key personnel were selected because of their:

1) Understanding of the mission and the technical needs of the Division functional units they represented, (engineering, marketing, manufacturing, etc.), and
2) Knowledge of subject in sufficient depth to determine and communicate its relationship to needs of individuals in their organization.

With the support of management, we asked these key people to serve as members of an ad hoc group to meet with us. We asked them to come prepared to describe:

1) The objectives they would like to have the training accomplish (i.e. what do they want participants to be able to do or know or "take away with them" when the program is completed). We asked them to describe their proposed objectives in as near behavioral terms[4] as they could.
2) The profile of prospective participants (technical background, work experience, education, age, current work assignments, etc.) and
3) The central themes and, if possible, specific topics they believed would be of most use to their operation.

These inputs served as the basis for discussion and the first step toward eventual agreement on parameters for the program prospectus.

Objectives for the first program planning meeting were to 1) select candidate topics in technical areas of need, 2) develop a "first cut" of objectives for the candidate topics, 3) develop a characterization of the participants for whom the program would be designed, 4) estimate size of potential need (number of students), and 5) explore, to extent possible, constraints and potential learning resources.

At this meeting we were able to accomplish our objectives. In so doing, we identified three levels of need (for management, the design engineer and the technician), examined the discrepancy between present and needed capabilities and developed rough objective statements. An example of learning objectives which eventually evolved from this meeting for one of the courses for design engineers is shown in Exhibit C.

The success of the first group meeting depended upon the group's ability to focus on and obtain general agreement for the course objectives and participant profile. Control was required by the moderator to prevent the discussion of how and what we wanted to teach before general agreement was reached on who the audience was and what we wanted to learner to "take away from the course".

Subsequent to this meeting, we prepared a draft program prospectus from the inputs obtained at the meeting. This prospectus was provided to the ad hoc group for review and comment. Ample time was afforded for this review to allow group members an opportunity to consult with colleagues in their organization. Feedback from the group members established the agenda for subsequent ad hoc group meetings. The process was iterative and continued until general agreement was obtained on a draft prospectus.

Completion of this process equipped us to examine potential education and training resources available to us and to determine which of the alternatives would best meet the Division's needs. It equipped us to effectively communicate our needs. We could, in effect, provide meaningful functional specifications to potential suppliers of education and training, whether they be an in-house training department, education institutions, professional societies or a commercial vendor.

A Microprocessor Training Program was developed to meet the different needs of managers, engineers and technicians. The levels of courses are illustrated in Exhibit A and the courses are described in Exhibit B.

After examining the potential resources and their unique capabilities to fill the different needs of various segments of the Program, two educational institutions near the Meter Division in Raleigh, North Carolina State University and Wake Technical Institute, and microprocessor vendors were employed to provide the required training. Courses supplied by the vendors were an essential part of the total program because of their unique capability of supplying training specific to the kinds of devices of interest to the Division. Some existing courses were available to meet the perceived Division training needs. For other needs, modifications of existing courses or design of new courses was necessary to meet our specifications for the total training package. In every case, our development process enabled us to select the appropriate educational resource and to effectively communicate our unique needs. It, in turn, enabled us and the educational institution to more efficiently determine whether it had the resources to meet them.

The Program consisted of an interrelated system of courses with a total of 338 contact hours; 141 attended the first full cycle of the Program. Cost of participation was paid by the Corporation. Participation in some of the courses required the personal time of the employee-student. Other parts of the Program were presented during working hours. Participation, while voluntary, was encouraged by the Division, but required commitment of personal time by the employee-students.

Time Table for Development

The timetable achieved for development and presentation of the Microprocessor Training Program was:

August	Identification and scope of the need for enhancing solid state capability in Meter Division.
September-November	Meetings of Ad Hoc groups (typically 2-4 meetings); Draft design of Training System Courses completed.
November-January	Negotiation with Universities and other potential educational resources.
February-November	Program begins with Overview Course for Managers and is completed with Microprocessor Course for Technicians.

Evaluation

Early in the Program development process, we asked ourselves, "What is the difference between what is being done and what is supposed to be done?" The discrepancy was important to the Division. Because the discrepancy was caused by a knowledge and skill-based deficiency, a program of formal courses and laboratory hands-on experience was developed.

The most crucial question, then, is, "What can the student do back on the job after training that he couldn't do before taking the course?" In the final analysis, this question has to be answered by the individual participant and his manager.

It was important to consider during the development stage how we were going to evaluate the effectiveness of the program and to establish the criteria for success.

To the extent that we were successful in developing clear objectives in as near behavioral and learner-centered terms as possible, we then also provided a more realistic basis for evaluating how well the course met its objectives. We have found Mager's book[4] to be very helpful in formulating course objectives. An example of the use of the objectives for course evaluation by participants is shown in Exhibit C, which shows part of the appraisal for the "Microprocessor for Designers" Course.

After completion of the Program, course evaluations were made through:

1) Evaluation (Opinion) questionaire by the program participants in which they were asked to appraise how well course objectives were met. See Exhibit C.
2) Evaluation by course instructors.
3) Evaluation by management.
4) Evaluation by engineering professionals of the effectiveness of the technical institute courses in meeting needs of the technicians who furnish support to them.
5) Anecdotal evaluations.

The Manager of the Meter Division summed up his evaluation of the comprehensive program as "instrumental in bridging our Division up-to-date in the fast-moving electronic technology. The speed at which these quality courses were defined and implemented was remarkable".

Lessons Learned

Although they may appear elementary, some of the lessons we have learned are:

1) Necessary requirements for a successful industry training program are:
    a) Management interest and commitment. From the beginning of the development process, management was involved. In the early phases of planning, the Division Manager and other key members of management met with the Head of the North Carolina State University Electrical Engineering Department. They also corresponded and met with the President of Wake Technical Institute. Several members of management attended (as students) all professional courses. Management also monitored the technician's courses.
    b) Student commitment and interest. Managers interviewed each potential student and enrollment was obtained on a strictly volunteer basis.
2) Need for management commitment to a broad systems approach where needs for improving performance and objectives are examined before deciding on a specific solution, such as a training course.
3) To successfully introduce a new technology, total participation by all Division personnel in a program at a level and degree appropriate to them is essential.
4) The continued ready access to faculty and availability of on-going courses are benefits of establishing relationships with local educational institutions. For example, the NCSU professors were subsequently employed as consultants and the continued need for technician training was met by Wake Technical Institute.
5) All possible training resources (in-plant, universities, technical institutes, vendors, etc.) should be examined to optimize the match between their capabilities and the needs of the Division.

Benefits

Course presentations at the Meter Division developed by the method outlined in this paper have satisfied the defined Division objectives as well as meeting many participants own personal objectives. Management feedback confirms that these courses met their stated objectives and that the objectives did, in fact, reflect the needs of their departments.

Application of this key group concept to guide the development of new training programs at the Meter Division resulted in:

1) A rapid specification of education and training needs and efficient communication of these needs to educational institutions. This resulted in more rapid initiation of the program.
2) Development of a training system which reflected the needs of the entire organization and sorted out those needs best met by training or education.
3) Involvement of management and learners in the success of the program.
4) Courses designed with user input which were responsive to their and the Division's needs.
5) Establishment of a meaningful channel of communications between departments, thereby affording cross fertilization of ideas and enhanced daily operations.
6) A means for managers to examine training needs of their people which are related to their organizational objectives.
7) Better selection of participants because of management's increased knowledge of the courses.

Acknowledgment

Appreciation is due North Carolina State University and Wake Technical Institute, the two educational institutions participating in the Program, and to the Westinghouse Meter Division management, staff and Program participants for their cooperation and support in the development and implementation of the Microprocessor Training Program.

Special appreciation is due: 1) to the instructors, Professors W. E. Snyder and J. W. Gault of NCSU and Professor Gene Hornick of Wake Technical Institute, who successfully designed and presented their courses to be responsive to the needs of the Meter Division and 2) to Dean L. K. Monteith, Assistant Dean J. R. Hart, D. E. Harrell and H. G. Walker, Jr. of NCSU and President R. W. LeMay and Dean T. I. Edwards of Wake Technical Institute, whose cooperation and support made the Program possible.

[1] Knowles, Malcolm, The Adult Learner: A Neglected Species, Houston, Gulf Publishing Company, 1978.

[2] J. J. Harald and J. R. Van Horn, Management Team Approach to Design Engineering Courses, Proceedings of the ASEE 1978 College Industry Education Conference, pages 10-14.

[3] Van Horn, J. R., Joint Development of Continuing Engineering Studies Programs: An Example of Industry Education Dialogue Using Ad Hoc Advisory Committees. Volume E-19, Number 1, February 1976, pages 22-25, IEEE Transaction in Education.

[4] Mager, Robert F., Preparing Instructional Objectives, Frearon Publishers, 1975.

EXHIBIT A:
MICROPROCESSOR TRAINING SYSTEM FOR WESTINGHOUSE METER DIVISION; LEVELS OF COURSES

- Overview Course for Management (Course I)

  Microprocessor for Managers and Support Personnel in Engineering, Quality Control, Manufacturing Engineering, Marketing, Industrial Engineering, etc.

- Courses for Engineers

  Basics of Electronics and Logic Design (Course II) Qualifying Course for Microprocessor for Designers Course.

  Microprocessor for Designers (Course III) Advanced Course.

  Vendor's Courses
  Addresses the Vendors Specific Product.

- Technician Training

  Technician Training Course (Course IV) Designed so that those completing course can give technical support to engineers who have completed the program.

EXHIBIT B:
MICROPROCESSOR TRAINING SYSTEM COURSE DESCRIPTIONS

In addition to the Vendor's Courses, courses were organized as follows:

I. Microprocessor for Managers and Support Personnel

This overview course was designed for Westinghouse managers and upper-level professional functions. It included an articulate frame of reference that management will use as an overview of the new techniques, processes and functions of the new generation of processing equipment. This course was conducted by North Carolina State University, lasted two full days.

II. Basics of Electronics and Logic Design

This course was tailored to meet the needs of engineers and engineering managers who needed updating to qualify them in this area prior to the more sophisticated material in the Course III.

The lecture part of this seven-week course was taught in-plant from 3:00 to 6:00 pm, twice a week by two professors from North Carolina State University. A "hands-on" session was conducted from 9:00 am to 12:00 noon in the University's engineering laboratory every other Saturday. Half of the lecture part and all of the Saturday laboratory work was accomplished on the student's time. Since the lab was on Saturday, away from the plant and production emergencies, attendance was excellent (one student missed one lab).

III. Microprocessor for Designers

This nine-week course met once a week from 3:00 to 6:00 pm and was attended by technical personnel who: 1) participated in Course II, or 2) already had the technical credentials sufficient to explore the more sophisticated aspects of the newer microprocessor systems.

This course provided an exposure to the: 1) vocabulary, 2) devices, and 3) design methods of microcomputer-based digital systems.

IV. Microprocessor Courses for Technicians

Three courses were designed to train engineering technicians to the technical level to support the engineers described in the Course III. The courses were tailored around the Division's needs, but also qualified as a curriculum credit course at Wake Technical Institute. The three-course program started March 3 and ended November 21, 1978. Courses met twice a week. The lecture portion met in the plant from 1:00 pm to 4:00 pm on Thursdays, while the lab was held at Wake Tech from 1:30 pm to 4:30 pm. This course has been so well received, it will be followed by a second course of technicians from Manufacturing and Quality Control. Note that this course, unlike Course II and III, was conducted completely on company time.

EXHIBIT C:
LEARNING OBJECTIVES

Appearing below is part of the participant Evaluation Questionnaire prepared by Professor J. W. Gault of North Carolina State University for "Microprocessor for Designers" Course, which illustrates use of behavioral objective statements in the evaluation process.

Upon completion of the course, participants appraised how well they could perform each of the learning objectives based upon four possible levels of proficiency.

The learning objectives were:

Upon completion of this program, an individual should be able to --

1. Draw the architecture for the M6800 M P U and related microcomputer system,

2. Describe the fundamental block diagram elements and behavior of any stored program machine,

3. Describe the signals and timing relationships for the M6800 bus,

4. Plan and describe by means of a flow chart a structured algorithm for a reasonable process (e.g., a vending machine),

5. Design and draw a logic diagram for a memory module of any geometry, selectably assigned to any block of addresses, using commonly available chips.

6. Describe by means of block diagrams the architecture of (a) a PIA and (b) an ACIA and define the software required to configure them for a typical application, and

7. Develop the microcomputer - based design for a reasonable problem (e.g., a small process control problem) to include

   a) The I/O definition for both programmed and interrupt driven I/O,

   b) An algorithmic solution description evolved in at least two steps of detail,

   c) Specify the type, location and amount of memory required for the system, and

   d) Write, assemble and verify detailed code to implement the algorithm.

EUGENE C. BENBOW

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Prior to his present assignment, he held various Engineering management positions and has 30 patent disclosures in his field.

He is an alternate member of the NEMA Watthour Meter Group, Electric Measurements Section, and was the senior U.S. Delegate to the International Electrotechnical Commission in Denmark in 1973.

He graduated from the University of South Carolina in 1951 with a B.S. Degree in Electrical Engineering and is a member of IEEE.

JOHN R. VAN HORN

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Before joining the Corporate Headquarters organization, Mr. Van Horn held various management positions in the Corporation's nuclear power activity. He conceived and produced the "Design of Experiments Course," a continuing engineering studies instructional package consisting of 32 video tapes and seven-volume self-study guide which has been used widely within and outside of Westinghouse.

He is a member of the American Physical Society, American Nuclear Society, and the American Society for Engineering Education, where he served as Chairman of the Continuing Engineering Studies Division. In 1977 he received the Division's Distinguished Service Award.

CONTINUING EDUCATION IN A LARGE TELECOMMUNICATIONS RESEARCH AND DEVELOPMENT ESTABLISHMENT

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Background

Bell Laboratories is the research and development arm of the Bell System. The Bell System operates a highly sophisticated communications network. Bell Laboratories is assigned the responsibility for research, development, and design of telecommunications equipment for use by the Bell System. To participate fully in this effort, members of Bell Laboratories must continually extend their educational horizons.

Bell Laboratories employs some 18,000 people at 16 locations in eight states. Of this total some 7,000 are members of technical staff, or engineers and scientists.

Ten years ago a large program of continuing education in engineering and science was inaugurated for members and associate members of technical staff. Since that time the curricula have been expanded and participation has been extended to other groups of employees whose needs can also be served by the program.

Corporate responsibility for the administration of the educational programs of Bell Laboratories rests with a group of professional and clerical people, both technical and nontechnical, located at Holmdel, New Jersey, who comprise the Education Center.

Needs Analysis

The identification of educational needs of employees is regarded as a highly important process. Perhaps it is not surprising that needs analysis in its various aspects is engaged in by technical managers, by the Education Center, and by the employee-participants themselves.

A great deal of study by a company-wide committee went into the initial planning of the program. Inputs included deficiencies in employee performance as well as areas of expertise into which the future needs of the company were expected to lead. Upon this base is built the tradition of reviewing the catalog of offerings every year to assure the alignment of the program of continuing education with the needs and goals of the company. In addition, a management committee reviews course offerings, examining at monthly meetings one curriculum or the offerings at one location. The same committee periodically reviews the goals and procedures of the program.

The participants themselves, for the most part experienced professionals who have the ability to identify many of their own needs, respond to an annual course needs survey, upon which the catalog of offerings is based. Their course registrations constitute the final decision. Since enrollment is voluntary, the retention rate is some measure of the degree to which the needs of the participants are satisfied.

The Education Center, continually in touch with managers, instructors, and participants, serves to bring to light needs which have not otherwise been discovered.

Publicizing the Courses

The high degree of involvement of both managers and participants in determining what is to be offered does in itself considerable to publicize the courses. The annual course needs survey leads to the publication of a catalog not unlike one that a university would put out. Form letters are sent out twice a year, at registration times, containing instructions and announcing deadlines. More or less concurrently the company newspaper carries similar information. Also, various subdivisions of the company may choose to highlight particular course offerings through lines of organization.

Formats

The majority of instruction in the program is via traditional instructor-led lectures. With a few exceptions, the course material is spread over specialties in each of which limited numbers of employees are working. A given need may therefore be satisfied by a small number of offerings of a course or even a single offering.

To meet concurrent needs at different locations video taping, live video, and an electronic blackboard system have been used. Videotapes also serve as a means of making up classes that employees miss.

Self-paced individualized learning is being used increasingly where sufficient numbers of learners are to be reached. The obvious advantage of flexibility in scheduling appears increasingly important. This learning mode utilizes appropriate combinations of video and audio tapes, workbooks, films, and slides.

Enrollment

Each term since the program began in the fall of 1969, some 2500 to 3000 employees have enrolled in almost 100 courses. Every effort has been made to offer courses which meet the needs of the employees. Among the registrants are senior employees who may experience difficulty in updating their educational backgrounds. In fact, during the early years a group of courses, appropriately called "ramp" courses, was offered in order to bring the registrants up to the level of the more advanced offerings. The spirit of the program includes a strong orientation toward the participant, with level and pace kept adequately high but with employee learning as the primary goal.

Staffing

A rotating group of Bell Labs technical staff, augumented by university faculty members in a ratio of about 1 in 5, does the teaching. In many instances expertise in the requisite subject matter is unobtainable outside the organization. In large measure, therefore, this program is a learning situation among peers. At one particular time, A may need to learn from B; and hence A sits in a class taught by B. At some other time the situation may be the reverse. No cadre of permanent instructors has been recruited.

Indicators and Evaluation

The participants themselves, the instructors, the committee members who continually review the program, and the administrators all have vantage points from which to derive indicators which, taken together, provide comprehensive means for evaluating the program.

The participants respond to the course needs survey not only by indicating their reaction to proposed alternatives but also by responding to a very short open-ended questionnaire.

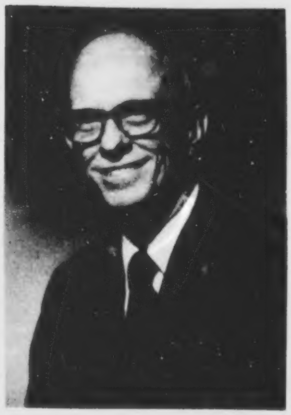
Registrations confirm the perceived value of a subject. In each offering of each course two questionnaires, one at the fourth week, the other at the end, appraise level, pace, organization, and subject matter of the course. Completion statistics, since enrollment is voluntary, also carry a message. Occasional opinion surveys reveal participant evaluation of the program.

Instructors monitor class attendance and file reports at the end of each course, evaluating that offering from their point of view. Reports by members of the steering committee of curricula and offerings at the various locations, made at their monthly meetings, include evaluative summaries. And, of course, the administrators receive many unsolicited comments in their contact with participants and instructors.

In addition, there is a member of middle management designated to watch over each course, responsible for its smooth running. These individuals provide valuable insights into the operation of the program.

Conclusion

A decade of operation has served to validate the tenets upon which this large program of continuing education was founded. Mature engineers and scientists in large measure assess their own needs, with major input from company management. The teaching is still largely traditional, but the use of individualized techniques has proved successful and is increasing markedly. Copious feedback throughout the program assures close coupling of the courses to corporate needs.



Carl R. Wischmeyer is Director of Education at Bell Laboratories, Holmdel, N.J.

Dr. Wischmeyer joined Bell Labs in his current position in 1968. He has served on the faculty of Rice University in various capacities, including professor of electrical engineering, master of Baker College, and director of continuing studies. He has also served as research associate at M.I.T. Radiation Laboratory, resident visitor at the Technische Hogeschool te Eindhoven, and consultant to industry.

The author of thirty published articles on electronic circuits, electromagnetic behavior of superconductors, and engineering education, he has been granted eight patents in the field of geophysics. He is a licensed professional engineer. He has served on the Boards of Directors of the Institute of Electrical and Electronics Engineers, the Engineers' Council for Professional Development, and Rose-Hulman Institute of Technology.

CONTINUING EDUCATION AND JOB PERFORMANCE: THE CASUAL CONNECTION

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INTRODUCTION

While no statistical study can ever prove causality, a Study has been completed which convincingly establishes associations between participation in continuing education (CE) and on-the-job performance which have been demonstrated not to be false based on any other variable that the Study could measure. The Study was performed under National Science Foundation Grant EPP75-21587. It measured relationships, based on objective data and not on attitudes or opinions. The results of this Study are reported in detail[1] and are highlighted in this paper.

The huge investment made every year in continuing education is because most employers and most people have faith that this educational effort is worthwhile. However, there has been little, if any, proof of this. Klus and Jones[2] reported positively on the effects of CE on salary and job satisfaction. Unfortunately, no attempt was made to determine true causal relationships. Dalton and Thompson[3] reported on attempts to correlate performance rankings with courses taken in prior years and found no relationships. In a later paper[4], Thompson, Dalton and Kopelman stated, "since both the level and timing of education seem important in maintaining competence, why does the number of courses taken on a continuing basis, either in-house or at a local university, appear unrelated to performance?".

Klus[5] stated: "No published statistical studies have been found which demonstrate to industry that possible end results of continuing education are increased productivity and/or quality, and ultimately increased profits." The Study reported here undertook the task of providing the missing statistical data.

It was decided to utilize archival data and to document an historical record of individual CE participation vs. measurable outcomes. As an add-on, a number of attitudinal questions were asked to provide information on Chief Engineers' rankings, technical and management job challenge and on each engineer's attitudes toward his CE experiences. What follows is an analysis of the data obtained from the participants. Each organization shows results which differ in interesting ways.

STUDY SAMPLE

Personnel from four large engineering organizations in the San Francisco Bay Area participated in the Study. They were Ford Aerospace and Communications (aerospace communications), NASA-Ames (government space and aerodynamics research laboratory), GTE-Sylvania (defense electronics) and FMC (machinery). Data were supplied by three hundred and ninety-six engineers, by current and first or earliest supervisors, by Chief Engineers and by the Personnel Departments. The organizations represent diverse activities. Of the total engineering population in these organizations, 14% (533) individuals volunteered to participate and 72% (396) of these provided data.

The volunteer sample contains self-selection bias. Most of those engineers who did not participate were either unwilling or unable to take the time required; a few did not believe in the Study. There is no way of knowing whether the 396 participants are representative of all engineers in their own organizations, of engineers in other disciplines, or in other geographic areas. However, the data received from each organization are broadly distributed and the patterns of the distributions are very similar. Based on the demographics, it is difficult to argue that the response group has any special or unique characteristics which would bias the Study. Nevertheless, an enlarged Study covering other engineering disciplines and other geographic areas would be needed to resolve the question of bias. As an example of the data distribution, Figure 1 shows the distribution of gradepoint average (IGPA) for all engineers combined.

VARIABLES

The variables used are listed in Appendix II. All participants were compared to each other at equivalent points in time (TEMPLY). Data on each individual were examined 3, 6, 9, 12, 15 and 18 years after this date, to the extent that the individual was represented in the sample for that period. Primary measures of performance were compensation and supervisory responsibility. Compensation was measured both in absolute dollars (OAC) (normalized by the annual consumer price index) and by relative compensation (ORC) (% increase each year relative to one's peers). Responsibility was measured by the number of persons supervised (OSP), as distinguished from level of technical responsibility. Other secondary but still objective measures of performance were the number of papers published (OPB) and the number of patents (OPT) issued.

The outcome variables were examined as a function of total CE (CETOT), technical CE (CETECH), business CE (CEBUS), and other CE (CEOTH). Further, to eliminate the effects of inherent ability and DRIVE, analyses were performed within ability groups and various mediating variables were controlled to determine the contribution of each.

The important mediating variables taken as proxy measures of inherent ability included various academic-related measures, such as gradepoint average (IGPA), quality of school (ISCH), academic honors (ISH), Master's Degree (M.S.) and Ph.D. Degree (PHD), as well as evaluations of Chief Engineers (OCR), present supervisors (IPR) and first supervisors (IFR).

Only a few variables determine the basic relationships, i.e., the number of hours of CE and the performance variables compensation and supervisory responsibility. All other variables were utilized only to determine causal relationships or to derive additional information to add to the total results. Sample sizes used to determine relationships of fundamental interest were always large enough to enable statistically significant findings.

CORRELATION ANALYSIS

Some 20,000 bi-variate correlations have been calculated between each pair of variables at six different points in time, i.e., years 3, 6, 9, 12, 15, 18 after TEMPLY. Only correlations which were statistically significant at values of $S^* \leq 0.05$ in two or more time periods have been counted. While the data for each period are unique, data on some individuals may be present in more than one time period. Therefore, the time periods are not truly independent. However, each time period has been analyzed separately and the results from different time periods have not been combined.

Each correlation between two variables is derived from a distribution such as shown in Figure 2. This sample scattergram shows the relationship between absolute compensation and participation in CETECH for all engineers combined in year 12. Clearly, to show 20,000 such scattergrams and attempt to draw conclusions from these would be impossible. Instead, a correlation coefficient (R) which represents the best fit straight line approximation between all points is used. R^2 is a measure of the percentage change in one variable attributed to a percentage change in the other.

Absolute Compensation vs. CE, Ability and DRIVE: Tables 1, 2, 3, 4 show the maximum bi-variate correlation between absolute compensation and level of different kinds of CE participation as well as DRIVE for NASA, FMC, Sylvania and All-Combined. Ford shows no useful results. It can be seen that NASA shows strong positive correlations with CETOT and CETECH and moderate positive correlations with CEBUS and CEOTH, and that these correlations persist strongly within groups of different ability levels. At FMC, the strongest and most consistent positive relationships are with CEBUS, whereas Sylvania is stronger with CETECH. All-Combined shows amazing consistency of correlations in the sense that diversity between groups tends to weaken the pattern. The following summarizes the bi-variate relationships shown between CE/DRIVE and absolute compensation:

		CORRELATIONS			
	CETOT	CETECH	CEBUS	CEOTH	DRIVE
Ford	---	---	---	Moderate	Moderate
NASA	Strong	Strong	Moderate	Mod-Strong	---
FMC	Moderate	Moderate	Mod-Strong	---	Moderate
Sylvania	Mod-Strong	Mod-Strong	---	---	---
All-Combined	Weak-Mod.	Weak-Mod.	Weak-Mod.	Weak	Weak

Note that the variable DRIVE is more weakly correlated than the CE variables, a result which was not at all expected.

The correlations show important relationships between CE and outcomes which are, to a significant extent, independent of ability. However, to determine the relative contributions of all independent variables to the outcome variables, multiple regression analyses have been performed. Tables 5, 6, 7, 8, 9 show the multiple regression data relating absolute compensation to CE, ability and DRIVE variables for Ford, NASA, FMC, Sylvania and All-Combined. Note that at Ford, the most consistent pattern is with DRIVE which explains up to 14% of the variation in absolute compensation. However, the NASA pattern is very strong with CETECH and explains up to 45% of the variation. The Sylvania pattern is similar to but not as strong as that of NASA. At FMC, the major pattern is with CEBUS which explains up to 45% of the variation. When All-Combined, both CETECH and CEBUS show persistent patterns, with CETECH being more dominant. In general, the ability and DRIVE variables do not account for absolute compensation nearly as strongly as the CE variables.

Supervisory Responsibility vs. CE, Ability and DRIVE: Tables 10, 11, 12 show maximum bi-variate correlations between supervisory responsibility and CE/DRIVE for FMC, Sylvania, and All-Combined. Neither Ford nor NASA showed useful results. At FMC, weak positive correlations, which persist fairly well within ability groups, are shown with CEBUS. Within ability groups, the correlations become quite strong. Note the stronger positive pattern with CEBUS at Sylvania and its clear persistence within ability groups. In the case of All Combined, the correlations have essentially disappeared as the diversity between organizations has destroyed the pattern.

Tables 13-17 show the results of multiple regression analysis. Both Ford and NASA show a weak negative pattern of correlations between OSP and CETECH. However, NASA shows a weak positive pattern between OSP and DRIVE. These patterns did not evolve from the bi-variate correlation analyses. On the other hand, both FMC and sylvania show clear positive patterns of correlations between OSP and CEBUS, with up to 52% of the variation in OSP attributable to CEBUS at Sylvania. Sylvania also shows a clear pattern of positive correlations between OSP and DRIVE, a pattern not shown in the bi-variate correlation data. The All-Combined data show no pattern of correlations with OSP, and this result parallels that shown in the bi-variate correlation data.

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*The probability that in a representative sample of a given size the variables would exhibit a relationship as strong as the observed relationship.

Other Variables: None of the details relating to the other variables are given here. However, what follows summarizes the results of all of the analyses.

STUDY RESULTS

Relative to Participation in Technical Continuing Education:

1. Growth in compensation is positively related.
2. Supervisory growth is negatively but weakly correlated.
3. Publishing of papers is positively but weakly related in organizations where such activity is important.
4. Only weak and not dependable relationships are shown with awarding of patents.
5. No relationship is shown with Chief Engineers' ratings.
6. Technical job challenge is negatively but weakly related.
7. Participation in non-credit courses (other than regular academic university courses) is more related to compensation performance than participation in courses for university credit. Also, participation away from employer's location and with non-academic related instructors seems better, when measured by compensation gain, than taking in-house courses or with academic-related instructors.

Relative to Participation in Business/Management Continuing Education:

1. Growth in compensation is positively related, but not as strongly as technical CE.
2. Growth in supervisory responsibility is positively related.
3. No useful relationships are shown with publications and patents.
4. Weak positive relationships are shown with Chief Engineers' ratings.
5. Management job challenge is consistently negatively related. The negative relationships are stronger than those between technical CE and technical job challenge.

Relative to Participation in Other Continuing Education:

1. Growth in compensation is positively related, but this relationship is much weaker than those shown by technical and business CE.
2. No useful relationships are shown with any other outcome variables.

Relative to Inherent Ability and DRIVE Variables:

1. Academic attainment is not useful as a predictor of growth in supervisory responsibility, of growth in compensation or of the ratings of the Chief Engineers.
2. DRIVE is relatively unimportant in determining growth in compensation. It is positively, but not as strongly as business CE, related to growth in supervisory responsibility. It is the strongest positive contributor to the ratings of Chief Engineers.
3. Academic attainment and DRIVE are consistently negatively related to job challenge.
4. DRIVE and inherent ability variables taken together, do not seem as important in determining compensation as participation in CE. Specifically, academic achievement (presumed here to be one measure of inherent ability), represented by gradepoint average and academic honors, advanced degrees and the quality of school attended, seems to make less contribution to performance than CE participation, except in isolated cases.

Relative to Timing of Attaining the M.S. Degree:

1. Compared to engineers who received the M.S. degree as full-time students, engineers who received the M.S. degree while fully employed show stronger positive relationships between business CE and compensation and between technical CE and relative compensation; but no relationship between other CE and compensation. However, engineers who received the M.S. degree as full-time students do show a positive relationship between other CE and compensation.

Attitudinal Responses:

1. The attitudinal responses of participants with respect to their CE experience are largely positive. As a result of CE participation, 80% had positive feelings about themselves and 85% had positive feelings about their intellectual perspective. The negative feelings expressed in these areas were respectively 3% and 5%. As related to their job, 71% were positive about job assignments, 91% were positive about job performance, 63% were positive about prospects for advancement, and 63% were positive about relationships with fellow workers. The negative feelings in these same areas were respectively 1%, 2%, 3% and 1%. However, as related to feelings about employers, only 51% were positive and 12% were negative.
2. Seventy-nine percent of the participants noted that--in their opinion--50% or more of their CE effort had "job-related" value. Eighty-four percent believed that 50% or more of their CE had "mental stimulation" value. Reflecting these opinions, over 40% of the respondents would establish policies which would provide support for CE which had up to 50% non-job-related con-

tent.

CONCLUSIONS

1. Participation in CE is more important as a predictor of job performance than the combination of DRIVE with all of the inherent ability variables utilized in the Study. This result was totally unanticipated. It was expected that the measurable effects of CE--if any--would be small compared to the effects of ability and DRIVE. While the reverse has been shown to be the case, it is possible that the variables used as surrogates for inherent ability did not completely represent all of the important attributes. However, until it can be demonstrated otherwise, it is believed that the proxy measures used would have revealed a lack of causal connection with CE--if such connection were not really there.
2. While the above results are based on a relatively small pilot group, and while they cannot be generalized to all engineers everywhere, the results clearly show causal relationships between CE and performance.
3. The stronger relationships demonstrated between technical CE and compensation, as compared to the effects of business and other CE, may relate to the far greater level of effort in technical CE reported by most engineers. Because of the wide disparity in level of participation in non-credit versus credit CE, it is not possible to conclude that credit technical courses are not as good as non-credit technical courses, or that in-house technical courses are not as good as technical courses away from work or that academicians are not good instructors. It is possible to conclude that:
    a. Non-credit technical CE is measurably effective in leading to increased compensation.
    b. For the sample group studied, non-credit technical CE was significantly more effective than credit technical CE.
    c. Non-academic instructors are capable of doing an effective job of teaching.
    d. Non-credit technical CE courses offered away from the place of employment can successfully impact on performance.
4. The results seem to indicate that the effects of CE participation may be cumulative over time. This may explain why engineers who participate in CE only rarely and sporadically may find that the expected benefits of such participation are illusory.
5. The findings also suggest that "mental stimulation", provided by exposure even to non-job-related courses may be an important factor. If so, organizational policies for CE support, which require the CE to be job-related, might be worthy of review. This view is further supported by the attitudes of the engineers surveyed about what policies they would establish in support of CE.
6. The positive relationships between technical CE and compensation and between business CE and supervisory responsibility are supportive of the concept of bifurcation of career paths. Some engineers concentrate on technical excellence, leading to increased technical responsibility and compensation; others move into a management path, where the reward system is more related to business/management expertise and supervisory responsibility.
7. The negative relationships exhibited between job challenge and participation in CE, academic attainment and DRIVE may relate to "increased expectations" on the part of the individual engineers relative to the jobs they feel they should be asked to perform. There is a limit in any organization in being able to provide for truly challenging job assignments.
8. Assuming that the positive relationships shown between participation in CE and job performance are valid, which is the cause and which is the effect? One can, for example, hypothesize that high performers are the people who chose to participate in CE. However, while this Study has not proved causation, it has established associations between CE and subsequent performance which have been demonstrated not to be false associations created by any other variable which the Study could measure. Since associations persist after adjustments for all threats to the causal relationship, one can accept the relationship as not false until someone produces an alternative explanation which can be measured and tested. Alternative explanations to the unusual and unexpected results may exist, but no valid ones have yet been discovered. For example, it is tempting to attribute the results to employers rewarding superior performance by encouragement to attend special CE programs or to employers directly rewarding participation in CE by added compensation and responsibility. Both of these possibilities were explored with the participating employers and neither explanation has significant validity.
9. Perhaps the most compelling aspect of the findings are their consistency across time intervals, organizations, ability groups and situations. These patterns of consistency in the results strongly support the reliability of the relationships discovered. The Study results rest as much on these data patterns as they do on the absolute strength of correlations.

APPENDIX I - REFERENCES

1. Morris, A., "The Return on Investment in Continuing Education of Engineers", Final Report, NSF Grant EPP75-21587, June, 1978.
2. Klus, J. and Jones, J., "Engineers Involved in Continuing Education - A Survey Analysis", ASEE Publication, 1975.
3. Dalton, G. and Thompson, P., "Accelerating Obsolescence of Older Engineers", Harvard Business Review, Sept.-Oct., 1971.
4. Thompson, P., Dalton, G. and Kopelman, R., "But What Have You Done for Me Lately - The Boss", IEEE Spectrum, October, 1974.
5. Klus, J., "Establishing the Case for Continuing

Education for Engineers", June, 1974, Report prepared for the Int. Working Group on CE for Engineers of UNESCO.

APPENDIX II - VARIABLES LIST

Outcome Variables:

OAC	Absolute compensation adjusted by consumer Price Index.
OSP	Number of persons supervised.
OCR	Chief Engineer's ranking.

Continuing Education Variables:

CETOT	Total hours of all continuing education (cumulative total of contact hours).
CETECH	Total technical continuing education hours (cumulative total of contact hours).
CEBUS	Total business continuing education hours (cumulative total of contact hours).
CEOTH	Total other continuing education hours (cumulative total of contact hours).

Ability Variables:

IPR	Present supervisor report.
IFR	First or early years supervisor report.
IGPA	BS undergraduate gpa.
ISCH	School.
ISH	Academic honors.
OCR	Chief Engineer's ranking.
PH.D.	Having a Doctor's Degree.
M.S.	Having a Master's Degree.

Other Variables:

TEMPLY	Year of first full-time employment after last degree as full-time student.
DRIVE	Work aggressively and diligently and spend extra hours when required.

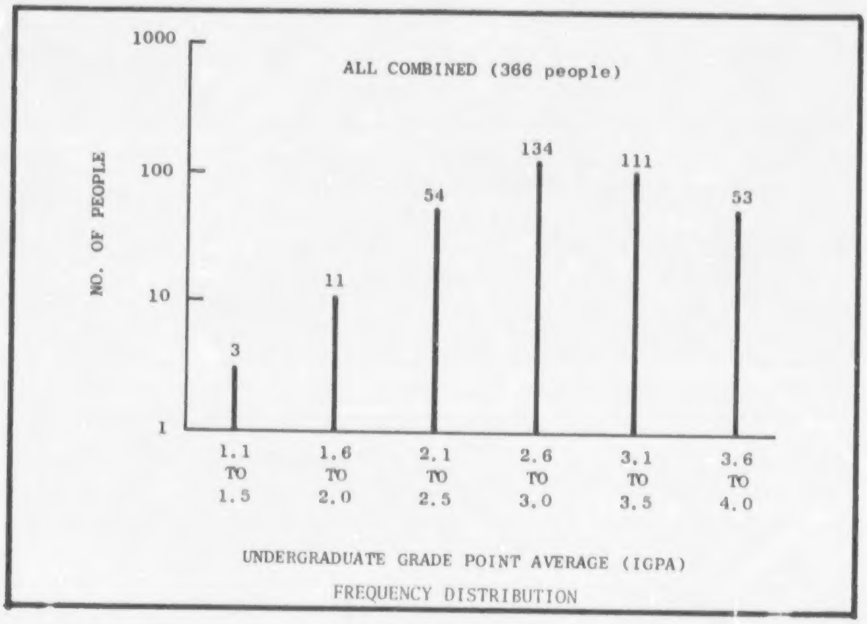


FIGURE 1

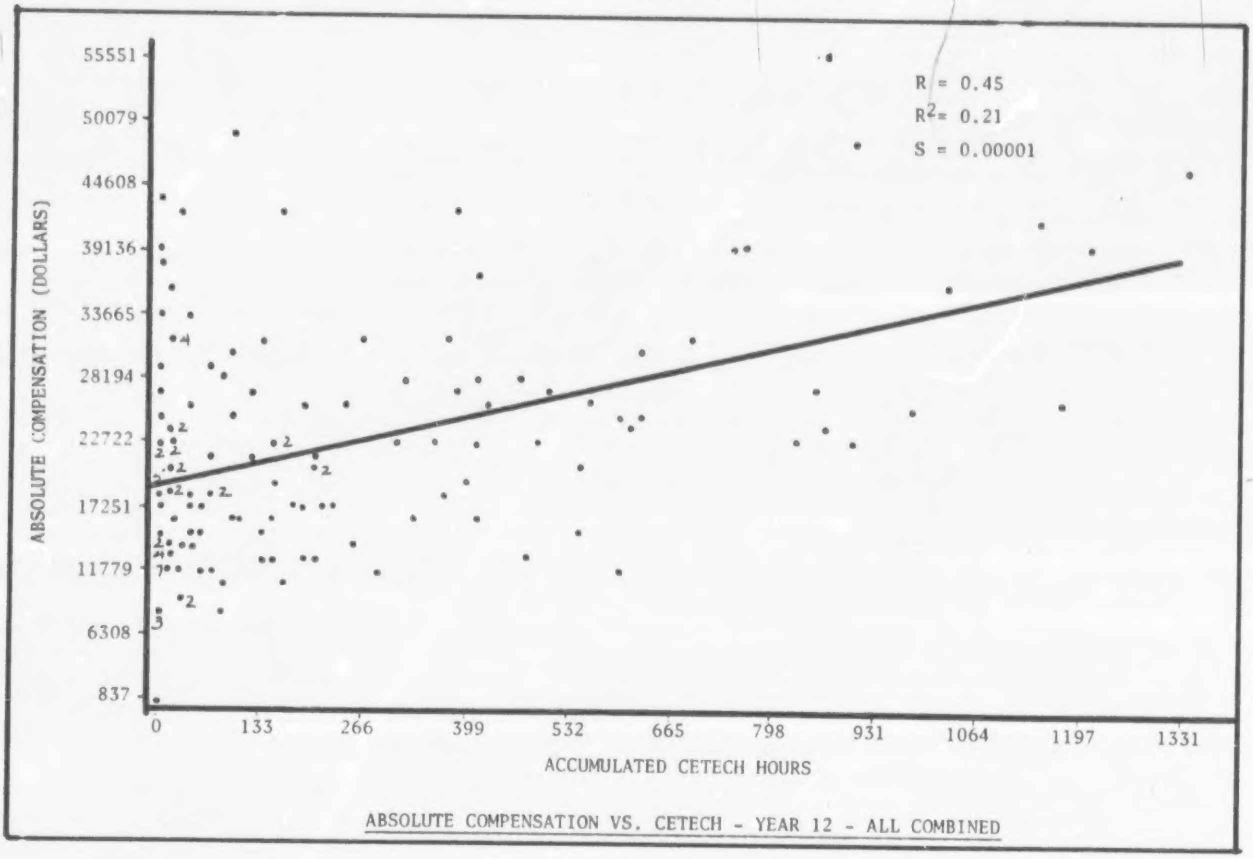


FIGURE 2

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE	+0.70	+0.67	+0.47	+0.56	
M.S.	+0.74	+0.67	+0.69	+0.58	
NO M.S.	+0.55	+0.52			
PH.D.				+0.68	
LOW SCHOOLS	+0.72	+0.69	+0.48	+0.69	
TOP SCHOOLS	+0.69	+0.69		+0.52	-0.44
LOW GPA	+0.69	+0.65		+0.58	
MID GPA	+0.63	+0.63	+0.96		
HIGH GPA	+0.91	+0.85		+0.64	
HONORS	+0.89	+0.79	+0.51	+0.64	
NO HONORS	+0.73	+0.70		+0.47	
LOW IPR	+0.82	+0.71			
MID IPR	+0.86	+0.88			
HIGH IPR	+0.88	+0.88		+0.78	
LOW IFR	+0.79				
MID IFR	+0.68	+0.65		+0.84	
HIGH IFR	+0.81	+0.83			
LOW OCR					
MID OCR					
HIGH OCR					

NASA - ABSOLUTE COMPENSATION VS. CE/DRIVE

TABLE 1

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE	+0.45	+0.38	+0.67		+0.44
M.S.			+0.81		+0.78
NO M.S.	+0.46	+0.42	+0.54		
PH.D.					
LOW SCHOOLS	+0.64	+0.57	+0.74	+0.55	
TOP SCHOOLS			+0.95		
LOW GPA			+0.88		
MID GPA			+0.80		
HIGH GPA	+0.56	+0.99	+0.87	+0.84	
HONORS	+0.79				+0.71
NO HONORS			+0.53		
LOW IPR		+0.86			
MID IPR		+0.71			
HIGH IPR					+0.99
LOW IFR					
MID IFR					
HIGH IFR					
LOW OCR	+0.70		+0.85		+0.83
MID OCR			+0.82		
HIGH OCR	+0.61				-0.77

FMC - ABSOLUTE COMPENSATION VS. CE/DRIVE

TABLE 2

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE	+0.66	+0.56			
M.S.			+0.45		
NO M.S.	+0.82	+0.78	+0.77		
PH.D.					
LOW SCHOOLS	+0.65	+0.57	+0.56		
TOP SCHOOLS					
LOW GPA	+1.00	+1.00	+0.74		
MID GPA					
HIGH GPA					
HONORS					
NO HONORS	+1.00	+0.81			
LOW IPR	+0.82	+0.82			
MID IPR					
HIGH IPR					
LOW IFR					
MID IFR					
HIGH IFR					
LOW OCR	+0.67	+0.50			
MID OCR					
HIGH OCR					

SYLVANIA - ABSOLUTE COMPENSATION VS. CE/DRIVE

TABLE 3

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE	+0.47	+0.45	+0.36	+0.21	-0.20
M.S.	+0.53	+0.53	+0.43	+0.42	
NO M.S.	+0.36	+0.28	+0.33	+0.26	
PH.D.					
LOW SCHOOLS	+0.49	+0.49	+0.39		
TOP SCHOOLS	+0.56	+0.50	+0.31		
LOW GPA	+0.69	+0.51	+0.52	+0.28	
MID GPA	+0.49	+0.39	+0.42		
HIGH GPA	+0.51	+0.51	+0.47	+0.50	
HONORS	+0.48	+0.47	+0.29		-0.31
NO HONORS	+0.55	+0.46	+0.46	+0.30	
LOW IPR	+0.54	+0.56			
MID IPR	+0.47	+0.48	+0.49	+0.40	
HIGH IPR	+0.62	+0.65			
LOW IFR	+0.56	+0.56	+0.48		
MID IFR	+0.53	+0.51	+0.42		
HIGH IFR	+0.45		+0.51		
LOW OCR	+0.40	+0.33	+0.42		+0.34
MID OCR			+0.61		
HIGH OCR			+0.49		+0.42

ALL COMBINED - ABSOLUTE COMPENSATION VS. CE/DRIVE

TABLE 4

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	11 (-)	-	3	4	-	3
CEBUS	-	7	10	-	3	-
DRIVE	11	9	2	-	-	14
PH.D.	9	6	-	-	-	4
M.S.	-	-	-	-	-	-
IGPA	-	-	-	-	-	-
ISH	-	-	-	-	10	7

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

34	20	17	8	13	31

FORD - ABSOLUTE COMPENSATION VS. CE/ABILITY/DRIVE

TABLE 5

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	2	29	45	39	38
CEBUS	22	5 (-)	-	2	-	-
DRIVE	13	-	-	-	-	-
PH.D.	16	10	-	-	2	5
M.S.	28	2	4	4	8	-
IGPA	2	17	-	-	-	-
ISH	15	6	3	-	-	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

98	42	37	53	51	45

NASA - ABSOLUTE COMPENSATION VS. CE/ABILITY/DRIVE

TABLE 6

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	15	-	3	17	7	3 (-)
CEBUS	3	10	16	3	27	45
DRIVE	5	19	13	12	3 (-)	5 (-)
PH.D.	-	11	-	-	-	-
M.S.	-	-	-	6 (-)	6 (-)	-
IGPA	13	4 (-)	18 (-)	-	8	-
ISH	-	-	-	-	-	3

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

38	48	52	38	52	58

FMC - ABSOLUTE COMPENSATION VS. CE/ABILITY/DRIVE

TABLE 7

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	-	11	13	7	31
CEBUS	-	-	4	3 (-)	-	20
DRIVE	-	-	3	-	7	5
PH.D.	8 (-)	-	-	2	21	5
M.S.	2	7 (-)	-	-	-	-
IGPA	-	-	-	5	-	-
ISH	8	5	-	-	-	3 (-)

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

22	16	22	25	37	65

SYLVANIA - ABSOLUTE COMPENSATION VS. CE/ABILITY/DRIVE

TABLE 8

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	-	5	21	11	7
CEBUS	3	3	6	-	4	13
DRIVE	3	4	4	-	-	-
PH.D.	3	4	-	-	3	2
M.S.	3 (-)	-	-	-	-	-
IGPA	-	-	-	-	-	-
ISH	2	-	-	-	-	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

3	6	9	12	15	18
16	14	17	25	18	24

ALL COMBINED - ABSOLUTE COMPENSATION VS. CE/ABILITY/DRIVE

TABLE 9

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE			+0.32		
M.S.					
NO M.S.			+0.67		
PH.D.					
LOW SCHOOLS					
TOP SCHOOLS					
LOW GPA					
MID GPA					
HIGH GPA					
HONORS					
NO HONORS			+0.66		
LOW IPR			+0.84	+0.98	+0.86
MID IPR					
HIGH IPR					
LOW IFR					
MID IFR			+0.71	+0.69	
HIGH IFR			+0.99		
LOW OCR	+0.66		+0.90		
MID OCR					
HIGH OCR			+0.76		

FMC - SUPERVISORY RESPONSIBILITY VS. CE/DRIVE

TABLE 10

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE			+0.72		
M.S.			+0.86		
NO M.S.			+0.66		
PH.D.					
LOW SCHOOLS			+0.81		
TOP SCHOOLS			+0.57		
LOW GPA			+0.70		+0.54
MID GPA					
HIGH GPA			+0.98		
HONORS			+0.95		
NO HONORS			+0.52		+0.45
LOW IPR					
MID IPR					
HIGH IPR			+0.83		
LOW IFR					
MID IFR					
HIGH IFR			+1.00		
LOW OCR			+0.72		+0.48
MID OCR					
HIGH OCR			+1.00		

SYLVANIA - SUPERVISORY RESPONSIBILITY VS. CE/DRIVE

TABLE 11

MAXIMUM CORRELATION

	CETOT	CETECH	CEBUS	CEOTH	DRIVE
ALL PEOPLE	-0.18				+0.17
M.S.		-0.19			
NO M.S.					
PH.D.			+0.89		
LOW SCHOOLS					
TOP SCHOOLS			+0.39		
LOW GPA			+0.29		
MID GPA					
HIGH GPA					
HONORS					
NO HONORS					
LOW IPR					
MID IPR					+0.42
HIGH IPR					
LOW IFR					
MID IFR					
HIGH IFR					
LOW OCR			+0.22		+0.33
MID OCR					
HIGH OCR					+0.38

ALL COMBINED - SUPERVISORY RESPONSIBILITY VS. CE/DRIVE

TABLE 12

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	4 (-)	4 (-)	2 (-)	-	-
CEBUS	-	-	-	-	-	3
DRIVE	5	-	-	2	-	4
PH.D.	-	-	-	-	-	-
M.S.	-	-	4	-	-	-
IGPA	-	-	-	-	-	-
ISH	3 (-)	-	-	3	3	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

13	7	11	10	8	12

FORD - SUPERVISORY RESPONSIBILITY VS. CE/ABILITY/DRIVE

TABLE 13

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	6 (-)	4 (-)	-	5	-	6 (-)
CEBUS	-	19	-	-	-	4
DRIVE	-	4	6	7	5	4
PH.D.	-	-	-	-	-	-
M.S.	-	-	9 (-)	3 (-)	7 (-)	5
IGPA	-	-	-	-	-	-
ISH	-	9 (-)	4	-	5	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

8	38	18	16	16	20

NASA - SUPERVISORY RESPONSIBILITY VS. CE/ABILITY/DRIVE

TABLE 14

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	-	-	-	-	5
CEBUS	-	-	-	10	10	7
DRIVE	12	3 (-)	-	-	-	-
PH.D.	-	-	-	-	-	-
M.S.	-	-	-	-	3 (-)	6 (-)
IGPA	2 (-)	8	-	-	4	4
ISH	11 (-)	-	-	-	-	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

27	14	5	14	20	23

FMC - SUPERVISORY RESPONSIBILITY VS. CE/ABILITY/DRIVE

TABLE 15

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	11 (-)	4 (-)	-	-	-	-
CEBUS	-	-	52	31	9	-
DRIVE	8 (-)	-	5	4	16	8
PH.D.	29	4 (-)	-	-	-	-
M.S.	-	4	-	-	-	-
IGPA	3	2 (-)	-	-	-	10 (-)
ISH	-	-	-	4 (-)	-	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

51	17	61	42	29	20

SYLVANIA - SUPERVISORY RESPONSIBILITY VS. CE/ABILITY/DRIVE

TABLE 16

% OF VARIATION IN OUTCOME EXPLAINED BY VALUE SHOWN

YEARS	3	6	9	12	15	18
CETECH	-	3 (-)	-	-	-	-
CEBUS	-	-	-	-	-	-
DRIVE	-	-	-	3	-	3
PH.D.	-	-	-	-	-	-
M.S.	-	-	-	-	-	-
IGPA	-	-	-	-	-	-
ISH	-	-	-	-	-	-

TOTAL % VARIATION IN OUTCOME EXPLAINED BY ALL VARIABLES

6	4	4	6	4	5

ALL COMBINED - SUPERVISORY RESPONSIBILITY VS. CE/ABILITY/DRIVE

TABLE 17

ALBERT J. MORRIS

President and Chairman of the Board, Genesys Systems, Inc.
Fellow of IEEE and AAAS and Member, Sigma XI.
Registered Professional Engineer, State of California.
Has served as Officer and Director of IEEE, WEMA, WESCON.
Has served as Consultant to fifteen universities.
Has served as Officer and Director of some dozen companies.
Has published thirty-six technical papers and reports.
Has one patent.
B.S., U.C. Berkeley, M.S. and Degree of Engineer - Stanford.

UPDATE '7X: A BALANCE OF PROBLEM SOLVING AND TECHNICAL PERSPECTIVE FOR EXPERIENCED ENGINEERS

Gary L. Pastre
Program Manager, Advanced Education
IBM General Products Division
San Jose, California

Summary

UPDATE '7X is a four-week program developed by IBM General Products Division in response to observed need for a means of succinctly updating experienced engineers whose careers had become specialized.

The primary objectives are
- Increased problem solving ability in a complex environment;
- Greater familiarity (at a structured overview level) with modern theory and technology, hence enhanced technical judgement;
- Broad intellectual stimulation and self-renewal.

Areas of concentration include:
- Problem solving tools and techniques;
- Analysis and Modeling of Physical Systems;
- Modern Technology, its underlying physics, current status and potential direction.

Key themes throughout are the economic use and value of information and the correlation of fundamental concepts in differing disciplines.

This approach has been found successful with engineers, programmers and technical managers at a variety of levels, and works well in concert with other company resources for balanced professional renewal.

Background

Products

The General Products Division of International Business Machines with headquarters in San Jose, California, produces storage subsystems (magnetic disk, tape, mass storage units and their associated controls) and printing subsystems, which are marketed through the IBM Data Processing Division and as subsystems of products sold by other divisions of IBM. We also have worldwide software development and maintenance responsibility for languages, data base and access methods, and related utility programs. Our division responsibility within the corporate structure extends to all phases of the products we produce except sales, including inception, development, manufacturing, and field support.

Our division's business environment is one of growth amid vigorous competition; of concern for designing economical processes as well as traditional assembly techniques.

People

Our products are made possible by a rich variety of people and technologies. Our current population is about eleven thousand and growing. Of these, some 8500 are located in San Jose, California, with satellite groups in Boulder, Colorado; Hursley, England; Endicott, New York, and with a rapidly growing new site in Tucson, Arizona.

Programs: Shared Responsibility

In general, IBM supports a broad range of education programs for its people, ranging from extended educational leave programs without pay to those with full pay and tuition covered by the company, and from after hours Voluntary Education programs to fully-paid training on company time.

A key concept in the administration of these programs is the SHARED RESPONSIBILITY concept. Both the company and the employee share the responsibility for individual (and therefore) company growth and vitality. Each brings to the enterprise their mutual resources of time, money, and energy in the approximate degree to which the results of the program at hand will directly benefit them. Thus, many of the programs are entirely funded by the company, and others are partially contributed to in time or money by employees.

Technologies

With this rich blend of people and programs is associated an equally rich spectrum of technologies which, in the engineering context, include mathematical simulation, vibration analysis, magnetic recording, integrated circuit technology, magnetic bubble technology, lasers, electrophotography, thin films deposition, ceramics and glasses, inks, microprocessors, human factors, physics, chemistry, electrical engineering, mechanical engineering, and others.

Needs

Jacob Bronowski in his book, The Ascent of Man showed examples of the breadth and depth of art-become-science on which technological progress is based.

But with this complexity and diversity comes the need for interspecialty communication. How many of you have heard an electrical engineer 'interpreting' a problem to a chemist... or vice versa? (Modern physics, it is said -- by non-physicists -- is the tool we have invented to allow this.) Another such need is for communication between engineers and programmers, who must effectively combine their skills to produce a computer system.

This need for inter-specialty communication is closely accompanied by another related need, that of business perspective -- that which translates the dialects of specialty back to the common language of the marketplace and customers' needs. In order that no one view unduly limit the flexibility of a product, a balance of perspectives is needed.

Some of the other needs which the program addresses are perhaps best described demographically. The people who compose the General Products Division can be categorized as managers, engineers, programmers, manufacturers, technicians, and administrators. The UPDATE program centers its efforts in areas of interest to engineers, in both managerial and non-managerial positions, who are most densely represented in our laboratory, and to a lesser extent, in manufacturing. About 75% of the people in the laboratory hold bachelors or advanced degrees. A significant percentage, 25% -- which includes many inventive people -- does not.

As can be said of a number of growth enterprises spawned in the post-war boom, our laboratory is experiencing 'increased maturity.' The average age in the laboratory is about 41. We are able to hire new young engineers, programmers, materials scientists, and so on, but certainly not in the numbers which would significantly affect or alter this trend. Also, with new hires a new challenge appears: that of the so-called "generation gap,"technically manifested. Due to the general size and complexity of our business, and due in part to the differences in notation between what was learned twenty years ago versus today (let alone the new sciences which have emerged in the last twenty years -- including computer science), new and mature engineers alike are frustrated by various degrees of inability to communicate with one another.

Objectives

About here is where one might feel a strategy emerging to aid the achievement of several of these objectives concurrently -- the objectives of coping with modern technology and complexity, enhancing self renewal, (which I increasingly tend to define as 'purposeful productivity'), and improving communication between specialists and between succeeding technical generations in the same field.

Variations of these objectives are in fact the objectives of the UPDATE program. In the early 1970's I became aware of several of the four-week refresher programs then (and now, due to their cost) run primarily for senior middle management throughout industry to help keep them in touch with new academic and technological developments. Notable among these was the Modern Engineering course, conducted by Professor Moshe Rubinstein of UCLA, which I attended. The stimulation and insight I gained through this experience convinced me that a large number of engineers and non-engineers, managers and non-managers would be similarly stimulated and enabled to function more effectively and flexibly by adding structure to their individual common knowledge and expertise.

With these goals and principles in mind, a four week fulltime program, 'UPDATE '73' was begun in that year, and has been running yearly since that time, with over 200 graduates to date.

Content

With these objectives in mind:

-- increased problem solving and communication ability in a complex environment

-- Greater familiarity (at a structured overview level) with modern theories and technologies, hence enhanced technical judgement

Broad intellectual stimulation and self-renewal,

let me share with you some of the structure, content and other factors which I believe help us achieve these objectives.

Figure 1 shows a menu of many of the topics, which are structured to fit together and relate to our business concerns as well as those of the individuals attending during the four weeks. Some are treated in more depth than others, but I believe that one of the major values added by the program is -- sometimes for the first time -- to show the relationship of the topics to one another, to a somewhat larger extent than is usually possible when studying the topics separately over time, and to determine as well the variety of contexts in which a given topic or combination of topics or tools can be applied.

((an example of this might be the application of a combination of basic matrix concepts with one of our favorite high-level programming languages, APL, and decision theory to produce a usable tool which can be applied to line yield, transportation, and data storage problems alike with very little modification.))

Themes

One of the 'themes' that our approach therefore both implicitly and explicitly teaches is that information when cohesively structured into appropriate contextual models, becomes increasingly valuable and 'portable' -- applicable to a variety of problems and situations, instead of one only. This is, of course, one of the central driving principles of the data processing industry.

Also, I believe that at its roots, recognition of the inherent beauty of structure in nature is one of the greatest inspirations to scientists, engineers, and programmers, who tend to measure their professions by the clarity with which they are able to articulate this structure, or to write not just programs, but well-structured, beautiful programs.

As our means of production in both hardware and software shift from a 'box' to 'distributed process' orientation, margin for error becomes increasingly small, as does the opportunity to locate an error within a system or process, once it has been committed. The disciplines related to this continuous challenge -- problem solving, modeling and analysis of physical systems, system and process control, all point to another major theme: coping with modern technology and complexity -- those elements of our activities which stubbornly refuse to take their place -- yet -- in the beauty of structure. In one sense, for our company, this program and others like it are a recognition that the scope of the issues today is broader than ever before, and that our actions bear implications of affecting our mutual environment, quality of life, level of communication, and very safety the world over.

Through considering the economic and environmental, as well as technical aspects of these subjects, we become increasingly willing to take responsibility for our actions and what they imply.

Success Factors

I would like to speak to some of the principal elements which I believe contribute to the success of this program.

Instruction

Of course, we have been fortunate to be able to work with a predominately excellent array of teachers who are a prime ingredient of every program's success. About 75% of the time is given to professors and consultants from outside IBM, and the remainder to selected experts from within -- who are selected with almost as direct reference to their teaching or 'group-relating' ability as to their expertise.

Without diminishing this element in the slightest, I would like to focus on a few other elements which might not be so evident.

Allowing For Individuality

Certainly success is a very difficult thing to measure. Even when it is achieved, it appears differently in the eyes of every individual. From an individual's point of view, therefore, we try to build into the program philosophy and execution the flexibility to set and achieve individual objectives. (One way we practically try to aid this is by providing adequate thought, individual study, and recreation time in the schedule.) Careful control of the program pace and provision for individual pace and interest are very important.

We ask attendees: "Was your technical judgement enhanced?" "Did you find new ideas, or new combinations of old ideas which will be helpful in your work?" (In our company philosophy, one is paid by the quality of work produced through education, rather than for education per se). "Were you mentally refreshed by the program?" In all these categories the responses are very positive, although as you can imagine, the actual ideas or work to which they refer vary widely.

A Programming Language

I must also credit the introduction of one of our 'high-level' programming languages (APL, as I mentioned before) for playing an important, if challenging role in the program success. We introduce it as an enrichment option because it brings great functional power to the solution of a wide variety of problems, once they can be thought of in its terms -- notably from a matrix-oriented approach. During UPDATE, learning APL (which is interactive) is a direct stimulus/reward experience; and when some part of it is mastered, it adds dimension and power to the problem solver's ability, greatly extending the number of variables one can deal with in a decision problem, for example.

It also provides an opportunity for those who already know some APL to team-tutor those who do not, thus reinforcing their own strengths while spreading the wealth.

The Place

Lastly, I must give a great deal of credit for the success of our program to the environment in which it has been traditionally conducted -- that of the beautiful University of California at Santa Cruz campus. The beauty, which should be evident from some of the illustrations, provides a refreshment all its own.

In addition, location on a campus adds an air of breadth, in which informal exchange of ideas with one another, university students, and faculty is a welcome enhancement to the formal portion of the program.

Being away from our normal business environment also provides an opportunity for objectivity -- viewing our activities from afar, re-examining them in new light, and matching notes with counterparts from other locations -- in a way that can only happen on 'neutral turf'.

The campus also provides opportunity for a variety of recreations, including just plain walking in a beautiful environment.

Business Factors

Business Factors which indicate success are both short term and long term in nature. The immediate refreshment which individuals gain accrues to the business advantage directly. We are able to build awareness of new products, processes, tools, techniques, and challenges which are very difficult to focus on with any scope in part-time programs. I believe we also achieve a level of interpersonal communication between the attendees which is all too easily lost in a large corporation and which continues long after the program ends.

Not infrequently, we are able to obtain or initiate solutions to business problems of varying scope (A recent one being a significant prediction of line yield). In some cases, inventions which were hiding shyly in the mind of an engineer have been encouraged and refined during the program. In all the long list of pragmatic managers and engineers who have taken the course, we have yet to receive a response that the program should not be re-offered.

The program itself continues to change with need, and I feel we have yet to realize its full potential.

Once again, I would like to emphasize that the UPDATE program is only one in a spectrum of regular and special courses and programs which IBM conducts. Its special value lies in allowing individuals to knit together some of the loose threads in the ravelled sleeve of experience, and quite the opposite of sleep, to challenge some of our old thought patterns, incorporate some new tools and points of view, and initiate change. Even though UPDATE is only one element of our continuing diet, we believe it is an essential element.

---

1. The Ascent of Man, J. Bronowski: 1973.

'UPDATE' PROGRAM CONTENT

MATHEMATICS HIGHLIGHTS (INTRODUCED TOPICALLY):

CALCULUS; DIFFERENTIAL EQUATIONS; MATRIX METHODS; STATE VARIABLES; PROBABILITY; STATISTICS; DESIGN OF EXPERIMENTS; LINEAR PROGRAMMING; CONTROL THEORY.

TOTAL PROPORTION: 10%

PHYSICAL SCIENCE

CLASSICAL PHYSICS AND CHEMISTRY REVIEW; SOLID STATE PHYSICS HISTORY & OVERVIEW; QUANTUM MECHANICS; SEMICONDUCTOR THEORY; MATERIALS CHARACTERISTICS; MAGNETICS; ELECTROSTATICS; POLYMERS.

TOTAL PROPORTION: 25%

TECHNOLOGIES

STORAGE TECHNOLOGIES (PRESENT AND FUTURE); PRINTING AND CIRCUIT TECHNOLOGIES; THIN FILMS AND SEMICONDUCTOR PROCESSES; ENVIRONMENTAL PROTECTION.

TOTAL PROPORTION: 15%

TOOLS

A PROGRAMMING LANGUAGE; PROGLEM SOLVING TECHNIQUES; DECISION MODELS; PROGRAM PACKAGES; TECHNICAL INFORMATION RETRIEVAL SYSTEMS; IDEAS FOR INDIVIDUAL VITALITY.

TOTAL PROPORTION: 20%

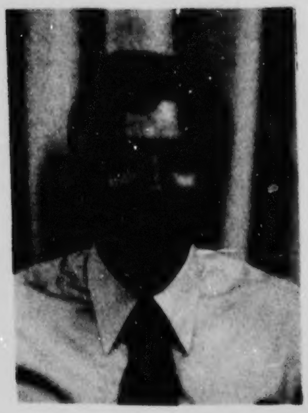
INFORMATION, LANGUAGE, AND CREATIVITY

INFORMATION VALUE, FORM, STRUCTURE AND CODING; COMMUNICATION SYSTEMS; DISTRIBUTED COMPUTING SYSTEMS; SATELLITE COMMUNICATIONS; LANGUAGES, TECHNICAL AND NATURAL; NATURE AND STRUCTURE OF THOUGHT; CASE STUDIES IN CREATIVITY; "ASCENT OF MAN".

TOTAL PROPORTION: 30%

FIGURE 1

GARY L. PASTRE



GARY PASTRE HAS BEEN ACTIVE AS AN INDUSTRIAL EDUCATOR FOR OVER TEN YEARS. HE HOLDS A BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING FROM U.C. BERKELEY. HE HAS DESIGNED AND IMPLEMENTED ADVANCED EDUCATION PROGRAMS FOR A WIDE VARIETY OF ENGINEERS, PROGRAMMERS, MANAGERS, AND INTERDISCLIPLINARY GROUPS, AND HAS SERVED AS PROFESSIONAL EDUCATION MANAGER FOR IBM GENERAL PRODUCTS DIVISION IN SAN JOSE, CALIFORNIA, SINCE 1973.

THE ROLE OF TRAINING IN CORPORATE SURVIVAL

Charles J. Sener
Director, Education and Training
Bell System Center for Technical Education
Lisle, Illinois

Engineers, as professionals, are in imminent danger of growing old.

Not old, in the sense of grey hair and wrinkles ... although that concerns some of us, too ... but old in the sense of losing touch with the state of the art.

Old in the sense that they can lose value in the eyes of the companies they work for, in the eyes of the world ... and in their own eyes.

Those of us in this room who are engineers understand the problem only too well.

Because all of our college degrees, as well as the engineering degrees of every promising graduate in the class of 1978 ... have one thing in common.

They are now obsolete.

They started becoming obsolete the minute we walked out the door of the ivy covered walls to seek our fortunes in business, academia and other bastions of the real world.

And our college degrees will continue to lose their value to us with every passing day, unless we do something about it.

I myself am a good example.

Only a few years ago, I felt smug about that degree. I felt that no matter what turns my luck would take, I could always earn my bread and butter with my slide rule.

I've lost that security.

Today, my slide rule is about as much use to me professionally as an abacus.

The machine that produced that slide rule is now on display at the Smithsonian in Washington, D. C. It is a relic, a piece of history for future generations.

But my slide rule is no more obsolete than the notion that an engineering degree lasts a lifetime. The magic of that degree, and the security it offered are gone.

For our companies, the implications of this reality increase exponentially. Each corporation has made a tremendous investment in people ... they have paid dearly for the expertise of thousands of engineering graduates ... and depreciation of that expertise is a price they can ill afford to pay.

Each of our companies ... and each of us as individuals ... faces the terrible dilemma posed in Future Shock. In less than ten years, half of what we know today will be useless information ... We are plunging headlong into a future for which we have been left unprepared by our past experiences and our education.

Like us, our companies are struggling desperately to keep their place in a constantly changing environment ... and to postpone their own obsolescence.

The question today is not should corporations offer continuing education ... but how.

And we, as training directors, have an uncommon opportunity to show them.

More than that, we have a responsibility to show them. Because the very survival of our companies may depend on our ability to understand their needs, respond to changes to their environments and to be uncompromising guardians of quality in the products we give them.

Things weren't always like that.

Not too many years ago, corporate training centers were the proverbial pasture.

Managers who had served their companies well were "laid to rest" in training, to live out their days away from the worries and frustrations of the real world.

When they came up with wild-eyed ideas, or overran the budget, management would smile benignly ... or wink knowingly at each other. At worst, they'd become exasperated. Training was a function that could not, would not, be measured or really budgeted. And training managers certainly could not be held accountable for the bottom line.

When it was done at all, training was often developed on a whim, and served like fried chicken to whomever was interested ... as much and as often as the budget would allow. Whether the knowledge was ever used or not was relatively unimportant.

But training today is going the way of the American diet. Only 15 or 20 years ago, if a little was good, more was better. A good restaurant was one that offered gargantuan portions of meat and potatoes, and a good family restaurant boasted about "bottomless" plates and all you can eat ...

Today, most Americans are eating less ... and more selectively. They've been scared off by stories in the newspaper and on television telling them that the food on their table can give them cancer, or age them prematurely.

And in the same way that the media changed American eating habits, technological change has altered the course of corporate technical training. Corporations today are training selectively, and they are training for survival.

The information needs of their employees are immediate and specific. Particularly when it comes to scientists and engineers, companies can't afford to train inefficiently. The price is too high, and there is simply not enough time.

These people must have the knowledge they need, when they need it, and no more than they need. Useless knowledge is only excess baggage in the technological race.

If corporate executives could, they'd administer skills and knowledge in pill form, so they'd lose as little time as possible in putting them to work for their companies. Training for a corporate president today has only one objective: Translating technical innovations into usable products and services. That is the bottom line.

They are putting hard-nosed business managers in charge of training.

They are selecting men and women who are cut out for new venture management ... people unafraid to take risks. People who have an entrepreneurial spirit. People who play for high stakes ... and stay with it until they win.

This changing attitude in our companies gives us advantages our predecessors never had.

Many of us do have the trust and support of our companies. We are in a position to do something.

But with that trust, we are also given responsibility.

And there is nothing sadder than the manager who has been given the trust of his or her company, and then abdicates responsibility.

In training, the most common form of abdication occurs when training directors begin to have visions of grandeur... They begin to worry more about running an academic institution than they do about meeting the needs of their corporations.

The result? Their staffs become a sort of intellectual elite, unable to come down to the level of the common field manager.

Their training centers lose touch with their clients. And training becomes an objective in itself. These directors soon establish a name for themselves as trainers, not managers of the business.

In some companies, the break is so severe that the training center becomes almost a separate organization.

This is a cardinal sin. It is the one mistake none of us can afford to make. Because if a training center is going to prevent its own obsolescence, it has to know its customers, and meet the needs of those customers. To do that, it must be an integral part of the corporation. If the fortunes of the business fall, so do those of the training center.

If the corporation's environment changes, trainers must be well-informed about those changes and ready to respond to emerging needs.

If training is going to be taken seriously .... and earn the trust which many of us already have earned ... then it must play by the same rules, have the same goals and use the same standards of measurement as any other part of the business.

Above all, training can't become an end in itself. Training centers ... and perhaps even their companies ... won't survive unless they are in touch with their customers ... that is, their students and the supervisors of those students.

They must know those customers .... respond quickly to the needs of those customers ... and maintain control over the quality of the product they give those customers.

Training directors are not in a position to tell their companies what they will or will not do. They must take direction from their customers.

Those essentially were the philosophies that guided us 15 years ago, when we sat down at a table with a handful of Bell System managers to develop a plan for the Bell System Center for Technical Education.

Our objective was to provide educational support for the Bell System's own objectives: Providing quality communications services at low cost. The only way a labor intensive industry can accomplish objectives like that is through well-trained and capable people. And it would be up to us to see that human resource planning kept pace with technical planning.

The planning process for our corporate center at Lisle took literally years. It is still going on.

And not everything we planned worked out ... Looking back, there are many things I'd do differently today. But overall, I know we've been successful by at least one measure ... We're pleasing our customers. And the reason for that, I think, is that - right from the beginning - we set out to run training like a business ... We had an unwritten agreement with our customers that we would do everything we could to meet their needs.

Here are some of the terms of that contract:

1. We would concentrate on only one segment of the Bell Systems training market .... technical management training. The rest would be up to someone else. But we would stay flexible enough to change if our customers wanted us to change.
2. We would run the training center like any other part of the business. We would use the same accounting systems, the same measurements, the same standards for staff selection and appraisal ... and the same standards for quality control of our product.

3. We would involve field managers every step of the way. They would compose our board of advisors and all our auxiliary councils and boards. They'd help us find training needs, set budgets and set priorities. We'd have grass roots project committees, with supervisors of potential students advising us on every new course development project. And we'd bend over backwards to communicate with field management ... in person, by telephone, in writing and through our publications. Finally, we'd include them on our own staff. Most of our instructors and developers would be field managers on assignment.

4. There would be one coordinator named at each company. This manager would be in charge of all the nuts and bolts arrangement in collecting and sending information on training to the field.

5. We'd be vigilant guardians of quality. Strict standards would be applied to all development and instruction. And we'd measure ourselves ... not only in terms of classroom performance, but in terms of how well our students perform back on the job. That would be our real test ... our only test.

As we went along, there were more agreements, of course. But these were the ones that stayed with us ... and left us flexible enough to grow, change and even reorganize to meet the needs of our customers.

Over the past ten years, the Bell System Center for Technical Education has grown from an organization of 55 employees teaching six courses to one with nearly 400 employees and a curriculum of well over 100 courses.

During that time, we never have had to look for students - they've been almost literally breaking our doors down to get in. Our only problem is finding enough places to put them.

The reason that happened, I'm sure, is the initial agreements we reached with our customers. They have, in fact, built our business for us.

For you, the agreements will be different. Your customers will be different.

And we are certainly in no position to write the Bible on how to run a training center ... even for us, there are chapters upon chapters that still need writing.

But what we can offer you is our outline -- the guidelines that have helped us achieve whatever success we now have.

There are four of them. And they will work for any of you, no matter what customers you serve or what measurements you use for success.

They are:

1. Stay in touch with your customers.

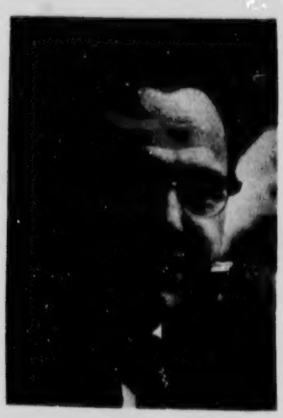
2. Respond to your customers' needs. But don't define your job so narrowly that you can't change when your company changes.

3. Be a responsible manager of your company's business. Don't get caught in the academic trap.

4. Guard the quality of your product with your life.

If you do just these four things and nothing else, I can almost guarantee you that you will play a critical role -- not only in preventing the obsolescence of engineering degrees -- but in the very survival of your company.

CHARLES J. SENER



Charles J. Sener has been director of the Bell System Center for Technical Education since it opened in 1968. He joined the Bell System in 1941. He has a B.S. degree in industrial engineering from the Illinois Institute of Technology in Chicago.

Sener is a member of the American Society for Engineering Education (ASEE), serving on the Executive Board of the Continuing Professional Development (CPD) Division.

An Executive Director of the National Engineering Consortium (Illinois), he also serves that organization as a member of the Industry Advisory Committee and the National Electronics Conference.

Sener is also affiliated with the Western Society of Engineers (WSE), the Illinois Chamber of Commerce, Pi Kappa Alpha Fraternity, and the Institute of Electrical and Electronics Engineers, Inc. (IEEE)

Since 1974, Sener has served the local educational community as a member of the President's Advisory Council of the Illinois Benedictine College, (Lisle, Illinois).

THE MYTH OF ENGINEERING OBSOLESCENCE

D. A. Keating
J. D. Waugh
J. M. Biedenbach
College of Engineering
University of South Carolina
Columbia, South Carolina

There have been few dogmas so pervasive in American engineering education in recent years as the concept of engineering obsolescence.

How often have we seen in the technical literature or heard in our engineering discussions the expression of technical obsolescence and the half-life of engineering education?

Perhaps we have seen it written and have heard it discussed so often that many of us in the engineering profession are beginning to think that it is true. If we think this, then the public sector probably thinks so too.

Myth or Reality

In pursuing the issue of whether "engineering obsolescence" is fact or fiction, and what to do about it, we would like to start the discourse with a very pertinent question. Are the American engineering schools really offering curricula that are geared to obsolescence?

We think not.

Yet, why is it that we in academia continue to speak in terms of educational half-life; and why is it that we often hear our senior and executive colleagues in industry, at many a meeting, continue to express the thoughts that "they've left engineering" or that "they don't do engineering anymore?"

Like it or not, this type of thinking and self appraisal has so swept the nation's engineering community in both academia and industry that it has overflowed into the non-technological arena as well, with the result that much of continuing engineering education today is oriented and directed as a cure for engineering obsolescence, rightly or wrongly.

Continuing Education - For What?

Although continuing education in engineering has been around for a long time, it has only taken hold in a major way in the United States since World War II, and it has probably become most active since the post-Sputnik craze of the '50's and '60's.

During this period, there was a deserved plea for emphasis to be placed on engineering science and on the basic fundamentals of engineering, along with mathematics. However, this had already been occurring for many years in many of the recognized schools of engineering. It was during this period when accreditation to minimum standards began to have real effect across the nation.

The first point we wish to make is that the undergraduate engineering programs and curricula of the stronger schools had already gone through a renaissance and, with slight modifications, were indeed sound. This is what resulted in their positions of preeminence in engineering education. The EDUCATION and training of engineers had always been a basic function of these universities or institutes, and a function they viewed seriously. These were schools of engineering with a professional outlook, and not schools of applied science. They were proud of their heritage and their traditions in engineering, and they were proud of their perceived role in the future. It could also be said that these programs enjoyed equal prestige with other curricula within the university, and they could grow on their own without need for emulation of the science departments. For the most part, the primary knowledge, skills, values, and attitudes gained from the better engineering programs were not obsolete then, nor are they today. Why? Because, the programs had meaningful objectives and they were based in a purposeful manner on a solid foundation that included the four main elements of undergraduate engineering education; namely, basic science, engineering science, applied technology and design, and liberal studies. Our profession builds on its strength and on its mission and purpose to serve society. That is why the curriculum was formed with the specific intent that it would serve the graduate in the future and not become out of date.

In looking at some of the pioneering programs in engineering education, we see that the leaders had much in common. There is no doubt that they talked with each other; they listened, and they learned from each other. They did indeed have an educational philosophy. It was strongly affirmed, and it was oriented toward professional education in engineering which would allow alumni to take leadership roles in the practice of the profession. Their objectives were straightforward and clear.

In pursuing this first point further, we decided to review some of the objectives and curricula that were in place twenty-five years ago in some of these pioneering schools. It should shock no one that we found the objectives and the curricula to be basically sound and on course with professional growth in engineering, both then and now. These programs were indeed professional and they had direction because there were some excellent deans and faculty in that era. We would like to bring to your attention the objectives of one of these pioneers, in particular, because those objectives seem to be as worthwhile today as when they were written twenty-five years ago. The words of Dean Hollister appeared in a Cornell announcement as follows:

> The broad purpose of engineering instruction is to provide the elements of learning and inspiration that foster leadership in professional and personal affairs. In the record of achievement of generations of engineers, the University has a trust to maintain a high standard of academic experience and to select those students whose abilities, character, and purpose show promise of continuing a tradition of leadership.
>
> Since the engineer has need of a balanced background, combining strength in fundamental technical knowledge with broad understanding of human affairs and competence in human relations, the plan provides for full integration of both areas of study. It holds to two major principles: (a) that preparation for the uncharted technological advances of the future can come only from a solid foundation in the fundamentals of science and engineering, and (b) that the total collegiate experience of the engineering student should be a stimulus to lifelong intellectual growth rather than a 'package' of incidental knowledge.....
>
> ...The creation of a sufficiently strong engineering background for professional growth requires the setting of deep roots in fundamental science and technology. This is the first step in the program for all engineers. For generations, alumni have been at the forefront of engineering progress in all fields principally because each was equipped with a foundation of solid, basic knowledge upon which he could build his own career. This continues to be the philosophy of the College. Although study of modern technical processes, laboratory experience, practical design methods, and individual projects occupy a substantial part of the program, all such work is related to major engineering fundamentals so that the student will gain insight for creative development from basic facts. Narrow specialization, with its restriction of opportunity and danger of obsolescence, is avoided....
>
> In all, the objectives are achieved through the mutual determination of the student and the college to develop in the period of his academic life the technical background and the personal culture that will support continuing growth over the full span of his professional career.

The second point we wish to make is that the majority of undergraduate engineering programs in the nation today are sound. In fact, it's been twenty years since Sputnik; twenty years of educational reform to redesign and implement engineering curricula based on solid fundamentals. This has been done; and in most cases, taken place throughout the nation.

Obsolescence of What?

What we've tried to convey in the preceding statements is an overview of where we've been in engineering education; where we are; and our foundation for the future. We have tried to address the issue of purposeful design in the building of strong engineering educational programs to minimize the mere transfer of information that may deteriorate with time, and to emphasize the human function of developing engineers with basic knowledge, skills, attitudes, and values as a solid foundation for continuous growth. Yet, the ghost of obsolescence still continues to haunt us in many deeply rooted ways. It occurs subtly, and as a result we fear that it has temporarily undermined the real concept of continuing engineering education.

The United States has seen a dramatic increase in continuing education during the last few years, but it may also witness a decreasing support of this activity in the years ahead unless continuing engineering education incorporates a new direction.

The reason is clear. Continuing engineering education, with a few notable exceptions, has not fully lived up to expectations and is not fully responsive to the needs of those it should serve.

The success of continuing engineering education has been primarily in the area of teaching methodology and adult learning. It has taken much of the trivia out of advanced education. However, on the whole, the activity is still searching for its identity and it is still attempting to determine the needs it should fulfill. In the short-range of brevity and survey courses, it has done well. However, in the long-range, it has yet to prove effective.

If we are to separate continuous education toward research and continuous education toward engineering practice, we see that graduate education toward research is well in place and time tested. This is not the case, however, for continuous education toward engineering practice, as noted at the 1974 NSF-Workshop on Continuing Education for Engineers at Midcareer held in Dallas, Texas.

It was at this major conference that we faced up to the issues that, "little is known about existing needs of the mid-career engineer," and that "course work has not been designed which correlates well with the professional growth of engineers."

We suggest, perhaps, that the present direction of continuing engineering education is a prime candidate for change.

The Emperor Has No Clothes

As we continue to explore the connection between continuing education and obsolescence, we are beginning to feel some of the trepidation and audacity the young lad must have felt, in the age old story, when he saw a wonderful procession, yet he also saw an emperor out front without proper attire.

Although many dedicated people appear also to see the situation, it is time to say aloud that continuing engineering education has been cloaked in the invisible garment of obsolescence, either intentionally or non-intentionally. We suggest that there be real fabric to the activity, and that its pattern be designed for the future rather than the past.

We note that continuing engineering education has evolved throughout the last few years with the goals: a) to maintain the competence of the practicing engineer, and b) to enhance the competence of the practicing engineer. We also note, however, that primary emphasis has been placed on the former goal. We suggest that it is time to begin to pay more attention to mission and purpose, and to formulate and implement long-range educational programs for the latter goal. It is our interest that this important advanced professional activity in engineering education begin to build on the solid foundation already set forth and in place; namely, to continue the education of the graduate engineer beyond the baccalaureate and into professional engineering practice. The changing needs of the mature engineer are a measure of growth, not of obsolescence. The failure of continuing education to recognize, and enhance, this growth may be a measure of its own obsolescence.

Hurrah for the Older Engineer

In further pursuit of a definition of obsolescence, we notice that a shift in thought is beginning to occur across the nation. We consider this to be healthy, and more in line with the concept of human development and continuous education. The shift that is occurring is that organizational obsolescence or ineffective utilization and development of the engineer may be the main culprit and not individual obsolescence. [Change in thought from Dalton and Thompson who previously reported "finding" a negative correlation in engineering between age and performance after 35.] Although this realization is occurring in some quarters, obsolescence is still primarily viewed in two other areas, namely:

a) Age and performance

b) Changing body of knowledge and lifelong education.

For some strange reason, age and practical experience in engineering has seldom been recognized as being respectable or distinguished as it has been in other professions such as medicine or law. After all, who would want serious neurosurgery performed by a neophyte if the chief neurosurgeon were available; or who would seek the services of the recent law graduate if the senior partner of the law firm were available. Yet, in engineering academia there are those who hold the view that individuals don't grow beyond their formal education, and that the recent graduate is always the best. However, it can be said that the twenty-two year olds did not head up the Mercury, Gemini, and Apollo manned space projects, nor do they run steel mills. In looking at age and performance, much is always written about age and learning. In fact, this is a periodic subject for the research grant, and it always appears to be a scientific breakthrough when it is reiterated that people beyond 40 and 50 years of age can still learn. It is often forgotten that this was a major finding of one of the first conferences on adult education during the 1920's in Cleveland, Ohio. Yes, adults can learn, and they can continue to be productive; in fact, much more productive than the younger engineer, if the working environment encourages it.

A second area of obsolescence is also greatly discussed, but often by those who appear not to understand engineering. These discussions usually emphasize the fast-changing body of knowledge, and the need for lateral lifelong education. This may be applicable to some professions, who practice their techniques learned in school. However, the engineer really doesn't practice in the same sense as others, but he transfers his conceptualized ideas to public practice. It also can be said that the engineer should perceive new knowledge as an opportunity to help him in his work and should not view it as a threat. His job is not to discover knowledge, but to use it in his conceptualization and execution of ideas in technological development. The scientist/researcher, whose purpose is to discover knowledge, may stay at the forefront of his discipline, but his discipline is likely to become increasingly narrow. There is a difference between science and technology, and between those who bring each about; namely, the scientist/researcher for the former and the engineer for the latter. It also may be said that the engineer not only deals with technological change, it is his purpose to make technological change. He brings it about, and part of this function is to create obsolescence by the continued improvement of products, services, or processes to meet the hopes, wants, and needs of society. The other point we feel that we have previously made is that a strong undergraduate education in engineering is based on solid fundamentals that are not ephemeral and that allow continuous educational and professional growth. We should not confuse the need for growth with obsolescence. We should provide an educational process to support that growth. The alternative is denial of our purpose.

Conclusion

In this paper, we have tried to present the present posture of American engineering education as a solid foundation for continuous advanced professional development. It is our view that the term "engineering obsolescence" has been overdone, and that its definition is weak. We find negativism within the engineering profession to be disturbing and to be ill-founded. We see no half-life in strong engineering education, and we view engineering as a profession that brings about change for specific purposes. It is all very well to talk about engineering education, but it is time to set new directions for continuing engineering education and to build this activity on the purpose and strengths of professional engineering practice. The problem is not obsolescence, but rather a lack of understanding of the effective utilization and continued advanced development of the engineer. It is not a problem, but an opportunity to continue the education and professional growth of each engineer toward his or her greatest potential in the profession of engineering. It is an opportunity that does not deal with the past; it is an opportunity that will help to define the future through better use of human resources.

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SCENES FROM MEXICO

Pyramid of the Sun
Teotihuacan

The Feathered Jaguar
Teotijuacan

SESSION 5A

METHODS OF NEEDS ANALYSIS CONTINUING EDUCATION PROGRAMS

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Determining needs can be considered the most critical part of continuing education programming. As such this session will be devoted to a group discussion on Current Methods of Need Analysis for Continuing Education Programs and their effectiveness in determining the perceived professional needs of engineers and technicians that can be in part or whole met by programs of continuing education whether conducted by professional societies, universities, or industry/government.

One method that is often used for collecting information about needs is the survey questionnaire. However, the responses from such questionnaires must be analysed with great care if misleading results are to be avoided - it is easier to obtain an indication of interest on a form than to generate actual participation.

Hopefully the group that meets in this session will review and discuss the relative merits of both formal and informal methods of need analysis such as postal surveys, telephone enquiries and interviews to selected engineering and scientific management, consultation with advisory groups, inquiries to specific national or local societies and associations and surveys at a national conference, or convention. In addition the major problems associated with these methods will be identified and discussed.

Another important consideration in the group discussion will be the desirability of developing a simplified survey questionnaire comprising of a number of basic questions which would be common to most countries together with some other questions specifically related to the particular organization or country undertaking the survey. In this connection the work of the UNESCO international working group on Continuing Education of engineers could well form the basis for discussion on this particular topic.

Coupled with this will be an examination of how best to utilize the data collected in order to derive maximum outputs from such exercises.

As an outcome of the group's discussions, including an exchange of international views, it is to be hoped that ideas and suggestions will be forthcoming on how to :-

(1) assess in an effective manner the continuing education needs of professional engineers and technicians both in industry and in academic institutions.

(2) identify meaningful and effective criteria which will assist program directors in determining and quantifying course priorities and their feasibility for development.

(3) determine the means whereby continuing educational needs indicated by engineers and technicians can be used as an information base for the development of programs and delivery systems within one nation, or group of nations.

MYRON W. CHIN

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He is the author of several technical papers and was Chairman of the First Caribbean Conference on Earthquake Engineering held in Trinidad in January 1978. He served as Rapporteur General of the UNESCO International Conference on the Education and Training of Engineers and Higher Technicians held in India in April 1976. He is currently Chairman of the Continuing Education Committee of the Council of Caribbean Engineering Organizations and a member of the UNESCO International Working Group on Continuing Education of Engineers.

PROMOTION TECHNIQUES FOR CONTINUING EDUCATION PROGRAMS

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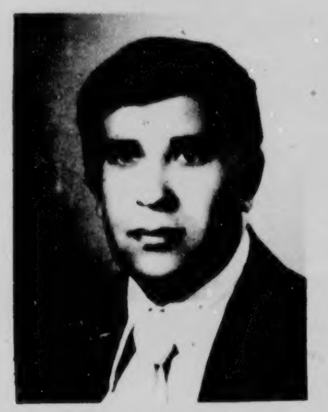
In this century of advanced technology, continuing education of engineers in most countries is becoming an important practice and effective tool for increasing production, improvement of quality and utilization of resources. Various professional societies, educational institutions and industries devote a good part of their activities to organizing continuing education programs. However, organizing a program, no matter how good it is, without finding the right beneficiary is a waste of time and resources. From this key point one could see the importance of the promotion techniques for continuing education programs, and furthermore the importance of choosing the suitable technique(s) for each program. Techniques of promotion vary widely in different countries depending upon their needs, resources available and administrative set-up. Also, they vary in any particular country depending on many factors such as cost, resources, organizing agency and the find of participants sought.

In any continuing education program three parties are principally involved: the agency offering the program, the organizations that delegate their employees for training, and the participants themselves. The promotion techniques adopted should suit the resources and system of the organizing agency on the one hand, and be effective enough to reach the participating organizations and individuals, on the other. In general, these must suit the needs of the industry and offer optimum utilization of finances and human effort involved.

An important and initial step in the promotion of any continuing education program is to ensure that the training program itself has been suitable selected to meet the urgent needs of industry. The objectives of the program should be clearly spelled out, and quality assured. After this has been done, the endeavour should be to obtain the enlistment of suitable participants for the program. An otherwise sound program may end in a fiasco if the trainees enlisted do not meet the basic requirements for the course. Such a failure qould earn a bad name for the organization and almost certainly affect future response to its programs.

Publicity for a prospective training program is generally needed at two levels, viz, among heads of the industry who would depute their employees for training, and among the prospective participants themselves. Contacts with the sponsoring authorities can be made through meetings, visits to industry, invitations extended to them for visiting the training centre, printed circulars and through personal semi-official communication addressed to them. The prospective participants can be reached through advertisements in proper newspapers and professional journals, and through announcements made over the radio and television etc. The selection of the media, as well as the time for advertising and announcing should be prdently made to ensure not only the best use of the money spent, but also the attention of professionals interested in availing themselves of the training program. A clear idea of the gains that the individual participants and industry in general, may attain from their involvement would help to draw increasing response to the announcements.

The need for efficiency among the program offering agency and its long term effect on the promotion of future programs can never be overemphasized. The reputation of the organizing agency would be an important factor in drawing response ot its programs. Mailing lists should be maintained up-to-date, and circulars should be mailed to the right people and organizations in time. Enquiries about training programs should be promptly answered to, and proper records kept for future reference. Information on past courses of training should be maintained and utilized in the planning of new courses. An after-training service should be offered to participants in case they seek any help when they have resumed their jobs after attending the training. It need hardly be said that the teaching program it self should be well conducted to the satisfaction of the individual participants and of their employing organizations. Good managerial talent in the program director is essential for the success of a program. His creativeness, resourcefulness, zeal and foresight would go a long way to enhance the effectiveness of functioning of the organizing agency and to earn a reputation of excellence so that less effort for conventional techniques of program promotion will be needed.



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AN APPLICATION OF CRITICAL PATH METHOD IN PLANNING CONTINUING EDUCATION PROGRAMME

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SUMMARY

The paper discusses the potential role of the critical path method in planning continuing education courses through a case study based on working experience at University of Technology, Baghdad. Several useful results emerge from the study. Besides providing a tool for day-to-day control on progress of work, the analysis provides information which can be made use of in deciding the number of courses that should be organized in a year if optimum utilization of available resources is to be ensured. This aspect, and some other valuable results of the study are discussed in the paper.

INTRODUCTION

Planning for short-term courses and executing them according to needs of industry constitutes an essential activity under continuing education. As soon as the need for conducting a course is established, the department of continuing education is faced with the task of organizing and tutoring the course. It is believed that a use can be made of the tools of scientific management for an effective fulfillment of this task. In this paper, an application of the critical path method in planning and executing of continuing education courses is proposed. A case study is considered to demonstrate the potentality of the proposed method.

NATURE OF WORK INVOLVED

The work of organizing short-term courses involves coordinating the work of different agencies and people. These include: industry, participating agencies, tutors, printing and duplicating services, departments owning lecturing facilities and the staff of the Continuing Education Department itself. Industry sets the needs for specific courses, while participating agencies depute their employees for undergoing the proposed training. Lecturers for the course have to be appointed from industry or from other teaching departments of the University. Often the Continuing Education Department does not own all facilities for printing and audio-visual aids. Arrangements for these things must be made in good time through contacts with other departments or people.

A work of this nature requires creativeness, resourcefulness and timely action; and could be greatly facilitated through use of the critical path method.

THE CRITICAL PATH METHOD (CPM)

This method aims at planning of complex projects in a simple, scientific manner which would facilitate execution through effective control and timely remedial action. The entire project is broken down into smaller costituents, called activities; and the precedence relationships among the activities are established. These are then arranged in a network diagram of arrows and circles, forming a graphical model of the project. Scheduling is done by putting time estimates of the activities under the arrows, and computing the earliest possible starting and finishing times of individual activities. The earliest finishing time of the last activity provides the project duration estimate. The longest path of activities through the network, from the start to the end, defines the critical path. A timely completion of the activities on the critical path ensures completion of the entire project within the scheduled period. For each activity its earliest time for start and earliest time for finish in terms of calendar dates can be found which help management in their day-to-day control of the work.

The CPM offers several advantages. It activates the thinking process while determining the precedence relationships of activities; and thus, improves an understanding of the complexities of the work. The responsibilities of different constituents of an organization to achieve the overall objectives are clearly defined. An identification of the key activities enables management to devote special attention to their timely completion. In case of delay, a remedial action can be taken before it is too late.

CPM STUDIES AT THE UNIVERSITY OF TECHNOLOGY (UOT)

In order to elucidate the proposed method the University of Technology (Baghdad) current continuing education programme was considered as a case study. The work of organizing and teaching of a continuing education course was broken down into its prominent constituents and analyzed through a CPM model. Figure I shows the network for organizing a single course. The break-up of the work, the order in which the constituents are taken up for completion, and the time estimates of the constituents are based on working experience at UOT and are given in Table 1. A working day is adopted as unit of time. These parameters have to be decided independently in each application. The total time required for the project, and the activities which form the critical path are shown in the figure. A 6-day course is adopted for the example.

Such a planning by any continuing education organization would be too naive, and would not be employed in practice. For, it is not practical to complete the run of one course fully before starting action on the second. A programme director would normally start working on the problems of several courses at the same time, and attend to each one with varying degrees of priority. Thus, while he is locating sources of support for the first course, some action is afoot for the second, and perhaps for the third course as well. Of course, his concern would be to carry on the work on the first course to such a stage that it "takes off" earliest, and then returns to complete blance of the work on the second and the subsequent courses. In the present case, advertising for a course is the "take off" stage, as further work does not demand organizer's immediate attention. At this stage he can resume work on the strategic part of the second course. In this way concurrent work on different courses would be the practical need.

In view of the above logic, a part of the work of the subsequent course is handled along with that of the preceding course, and the balance of the work only is required to be completed when action on this second corse is resumed. a shorter period would, therefore, be required for its completion than was needed for the preceding corse. As more courses are added to the planning horizon, the time needed would decrease for each additonal course.

Theoretically, this would mean that if planning is done on several courses at the same time, a stage would be reached when the duration for the last course would be zero. In reality this would never happen as it would not be practical to take up concurrent work on a large number of courses. Urgent things would be lost sight of, execution become difficult, and more time taken in completion rather than less. Every organization would have its limitations in this respect, the individual calibre of the programme director being an important one. An optimum number of courses in the planning horizon should be the objective of the programme director.

To study this aspect, network studies were made for planning of 2, 3 and 4 courses simultaneously. These are shown in Figures II, III and IV respectively. The respective project data is given in Tables 2, 3 and 4. The sequencing of the activities and their time estimates are based on the above mentioned logic. Each network shows the project duration and its critical activities.

From the results of the above studies several interesting facts can be observed. The total period for executing 1, 2, 3 and 4 courses comes to 51, 66, 74 and 78 work days respectively. A single course can be planned and executed in 52 days; but, if two courses are planned together, 66 days would be needed, i.e., an increase of 14 days would result. If a third course is added, the further increase in project duration would be 8 days; and a fourth course included in the spectrum would add only 4 days to the project duration. The 4-day increase results from duration of three activities, viz., locating support for course IV (1 day); appointing tutor and formulating syllabus for course IV (1 day); and advertising for course IV (2 days). If a fifth course is added such that part of the work on this course would have been done while completing action on the fourth course, to complete the balance of work on it the additional time of 4 days (as mentioned in the case of fourth course) would still be required. At the same time the task of the programme director would be rendered more onerous due to addition of the fifth course. In all fitness, therefore, the optimum planning horizon in terms of courses operated concurrently should comprise of 4 courses, involving a total working time of 78 days, adding a margin for holidays at 20%, a calendar period of about 3 months would be required. This gives an optimum of about 16 courses during a year, with the work information as adopted in the study. This would ensure the best utilization of the available resources of the continuing education department. If a larger number of courses is required to be run, the extent of additional staff needed can be estimated.

The critical activities have been indentified in the network. Special attention of the programme director to the timely completion of these activities would be necessary in order to ensure that the schedule is met. A date-wise schedule can be drawn up showing the starting and finishing dates of the activities, and this can be used for a check-up on the day-to-day progress of work.

Based upon the duration of activities, the requirements of resources, such as desk-hours, lecture room or laboratory occupancy etc., can be worked out. It would be possible to determine the precise dates between which a particular course must be run, at the beginning of the year itself. This would enable timely arrangements for the teaching aids to be made for each course.

It is seen from the studies that course duration has little effect on the overall duration of the project. For instance, an increase of 1000% in contact teaching hours would increase the project duration by only 6 days, i.e., by about 11% only, in the case of organizing of a single course. The percent increase would be smaller in case more than one course is planned concurrently. Thus, from organizations' point of view longer periods for duration of individual courses seem highly justified. However, there are many other factors, such as, the objective of the course and secondment of participants which influence the course duration.

TABLE - 1 - PLANNING A SINGLE COURSE

Indent.	Activity	Precd. Activity (Dur.)
A	Mobilize	-(6)
B	Locate sources of support	A(6)
C	Appoint tutor and form syllabus	B(6)

Indent.	Activity	Precd. Activity (Dur.)
D	Advertise	C(10)
E	Receive nominations	D(15)
F	Receive lecture material	C(15)
G	Print lecture material	F(10)
H	Arrange for lecture facilities	B(3)
I	Conduct teaching	E,G,H(6)
J	Receive and examine initial response	I(1)
K	Update record and wind up	J(2)

TABLE - 2 - PLANNING TWO COURSE AT THE SAME TIME

Indent.	Activity	Precd. Activity (Dur)
A	Mobilize	-(6)
B	Locate sources of support for course I (and partly for course II)	A(6)
C	Locate sources of support for course II (balance)	F(4)
D	Appoint tutor, formulate syllabus for course I (and partly for course II)	B(6)
E	Appoint tutor, formulate syllabus for course II (balance)	C(4)
F	Advertise for course I (and some work for course II)	D(10)
G	Advertise for course II (balance)	E(6)
H	Receive nominations for course I	F(15)
I	Receive nominations for course II	G(15)
J	Receive lecture material for course I (and partly for course II	D(15)
K	Receive lecture material for course II (balance)	E(10)
L	Print lecture material for course I (and partly for course II)	J(10)
M	Print lecture material for course II (balance)	J,K(6)
N	Arrange for lecture facilities for course I (and partly for course II)	B(3)
O	Arrange for lecture facilities for course II (balance)	C(2)
P	Conduct teaching for course I	H,L,N(6)
Q	Conduct teaching for course II	I,M,O(6)
R	Examine initial response for course I	P(1)
S	Examine initial response for course II	Q(1)
T	Update records and wind up course I	R(2)
U	Update records and wind up for course II	S(2)

TABLE - 3 - PLANNING THREE COURSES AT THE SAME TIME

Indent.	Activity	Precd. Activity (Dur)
A	Mobilize	-(6)
B	Locate sources of support for course I (and partly for course II and III)	A(6)
C	Locate sources of support for course II (and partly for course III)	H(4)
D	Locate sources of support for course III (balance)	I(2)
E	Appoint tutors, formulate syllabus for course I (and partly for courses II and III)	B(6)
F	Appoint tutor, formulate syllabus for course II (and partly for course III)	C(4)
G	Appoint tutor, formulate syllabus for course II (balance)	D(2)
H	Advertise for course I (and some work for courses II and III)	E(10)
I	Advertise for course II (and some work for course III)	F(6)
J	Advertise for course III (balance)	G(4)
K	Receive nominations for course I	H(15)
L	Receive nominations for course II	I(15)
M	Receive nominations for course III	J(15)
N	Receive lecture material for course I (and partly for courses II and III)	E(15)
O	Receive lecture material for course II (and partly for course III)	F(10)
P	Receive lecture material for course III (balance)	G(8)
Q	Print lecture material for course I (and partly for courses II and III)	N(10)
R	Print lecture material for course II (and partly for course III)	O,Q(6)
S	Print lecture material for course II (balance)	P,R(4)
T	Arrange for lecture facilities for course I (and partly for courses II and III)	B(3)
U	Arrange for lecture facilities for course II (and partly for course III)	C(2)
V	Arrange for lecture facilities for course III (balance)	D(1)
W	Conduct teaching of course I	K,Q,T(6)
X	Conduct teaching of course II	L,R,R(6)
Y	Conduct teaching of course III	M,S,V(6)

Ident.	Activity	Precd. Activity (Dur)
AA	Examine initial response for course I	W(1)
BB	Examine initial response for course II	X(1)
CC	Examine initial response for course III	Y(1)
DD	Update records and wind up course I	AA(2)
EE	Update records and wind up course II	BB(2)
FF	Update records and wind up course III	CC(2)

TABLE - 4 - PLANNING FOUR COURSES AT THE SAME TIME

Indent.	Activity	Precd. Activity (Dur)
A	Mobilize	-(6)
B	Locate support for course I (and partly for other courses)	A(6)
C	Locate support for course II (and partly for remaining courses)	J(4)
D	Locate support for course III (and partly for course IV)	K(2)
E	Locate support for course IV (balance)	L(1)
F	Appoint tutor and formulate syllabus for course I (and partly for other courses)	B(6)
G	Appoint tutor and formulate syllabus for course II (and partly for remaining courses)	C(4)
H	Appoint tutor and formulate syllabus for course III (and partly for course IV)	D(2)
I	Appint tutor and formulate syllabus for course IV (balance)	E(1)
J	Advertise for course I (and some work for other courses)	F(10)
K	Advertise for course II (and some work for remaining courses)	G(6)
L	Advertise for course III (and some work for course IV)	H(4)
M	Advertise for course IV (balance)	I(2)
N	Receive nominations for course I	J(15)
O	Receive nominations for course II	K(15)
P	Receive nominations for course III	L(15)
Q	Receive nominations for course IV	M(15)
R	Receive lecture material for course I (and partly for other courses)	F(15)
S	Receive lecture material for course II (and partly for remaining courses)	G(10)
T	Receive lecture material for course III (and partly for course IV)	H(8)
U	Receive lecture material for course IV	I(6)
V	Print lecture material for course I (and partly for other courses)	R(10)
W	Print lecture material for course II (and partly for remaining courses)	S,V(6)
X	Print lecture material for course III (and partly for course IV)	T,W(4)
Y	Print lecture material for course IV (balance)	U,X(2)
AA	Arrange for lecture material facilities for course I (and partly for other courses)	B(3)
BB	Arrange for lecture facilities (and partly for remaining courses)	C(2)
CC	Arrange for lecture facilities for course III (and partly for course IV)	D(1)
DD	Arrange for lecture facilities for course IV (balance)	E(1)
EE	Conduct teaching for course I	N,V,AA(6)
FF	Conduct teaching for course II	O,W,BB(6)
GG	Conduct teaching for course III	P,X,CC(6)
HH	Conduct teaching for course IV	Q,Y,DD(6)
II	Examine initial response for course I	EE(1)
JJ	Examine initial response for course II	FF(1)
KK	Examine initial response for course III	GG(1)
LL	Examine initial response for course IV	HH(1)
MM	Update records and wind up course I	II(2)
NN	Update records and wind up course II	JJ(2)
OO	Update records and wind up course III	KK(2)
PP	Update records and wind up course IV	LL(2)

CONCLUSIONS

The use of network technique of critical path method can be used effectively in planning for continuing education courses. Each case, however, needs an independent study based on the factual information on break-up of work, dependencies and time estimates. In each case the activities that form the critical path and the strategic activities that control time increase resultant from adding more courses to planned bunch may be different. The method discussed has a large potential for optimum utilization of the available staff of an organization, and for predicting the specialization and number of the new staff needed.

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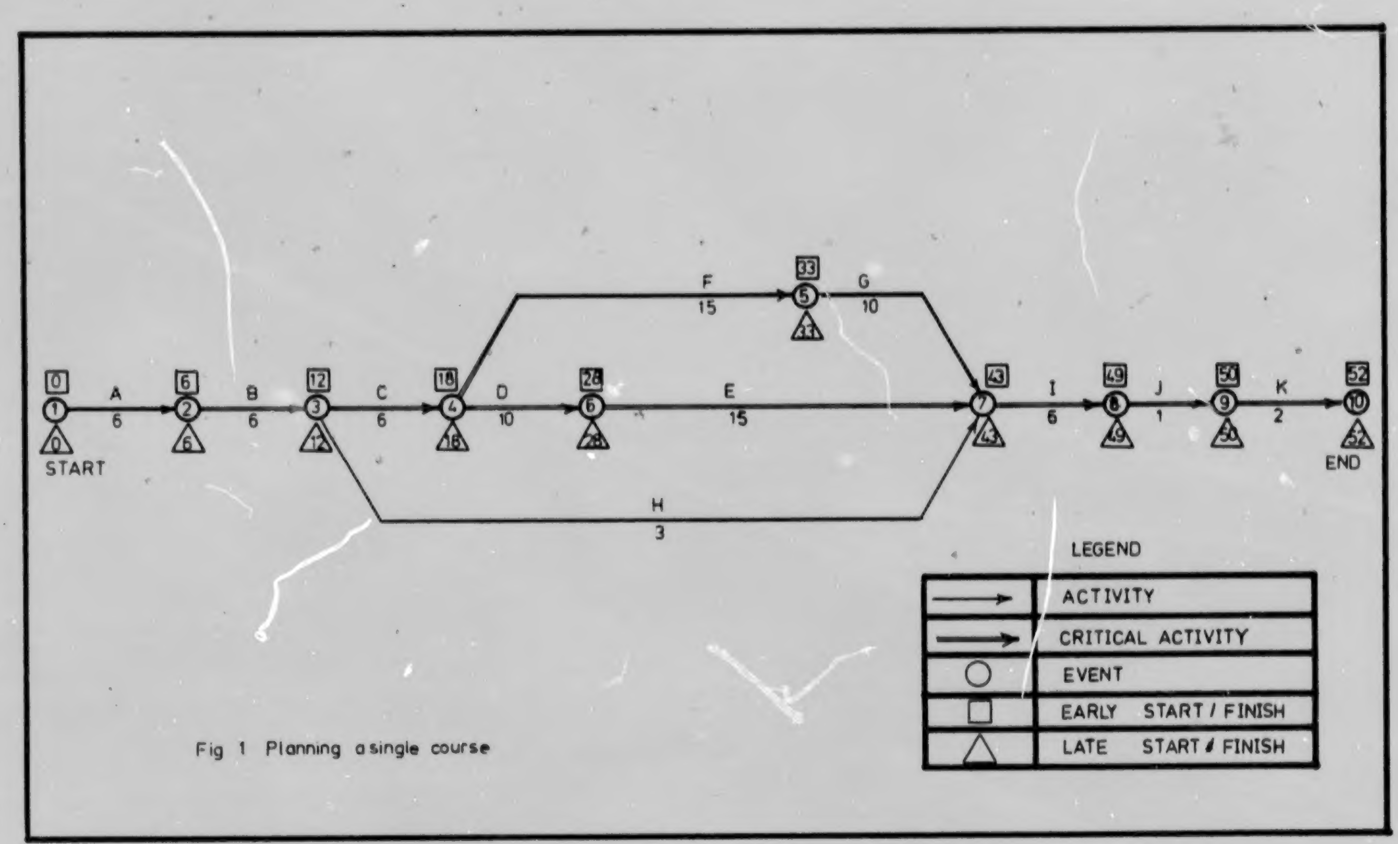
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END
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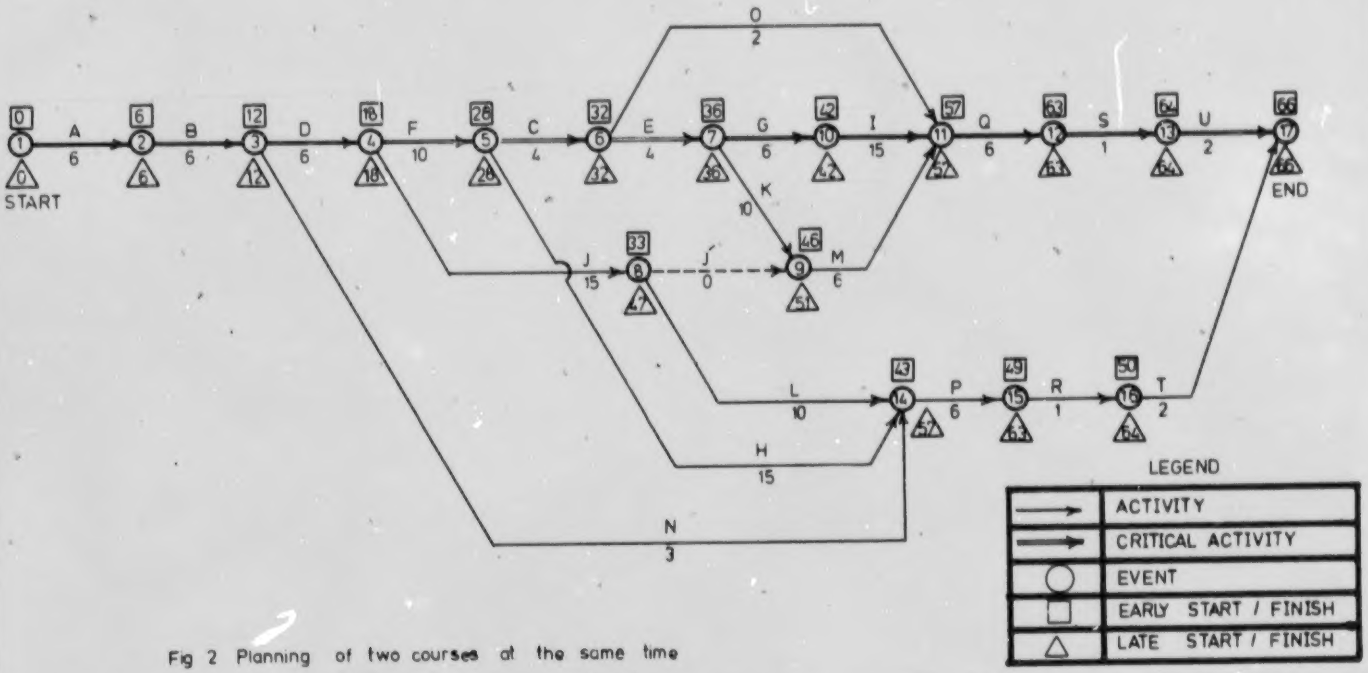
B 6
C 6
D 10
E 15
F 15
G 10
H 3
I 6
J 1
K 2
1 2 3 4 5 6 7 8 9 10
0 6 12 18 33 28 43 49 50 52
0 6 12 18 33 28 43 49 50 52
LEGEND
ACTIVITY
CRITICAL ACTIVITY
EVENT
EARLY START / FINISH
LATE START / FINISH

Fig 1 Planning a single course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END
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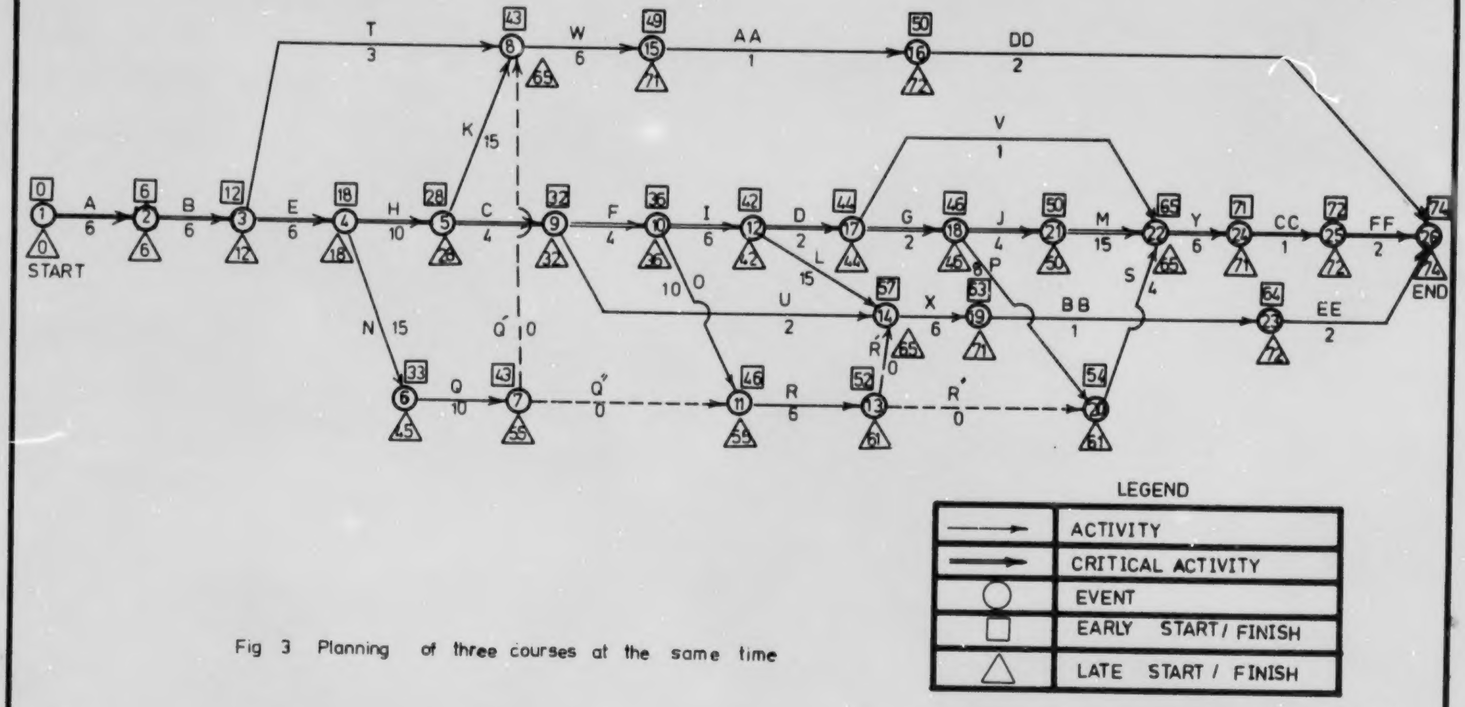
D 6
F 10
C 4
E 4
G 6
I 15
Q 6
S 1
U 2
O 2
K 10
J 15
J' 0
M 6
L 10
H 15
N 3
P 6
R 1
T 2
LEGEND
ACTIVITY
CRITICAL ACTIVITY
EVENT
EARLY START / FINISH
LATE START / FINISH

Fig 2 Planning of two courses at the same time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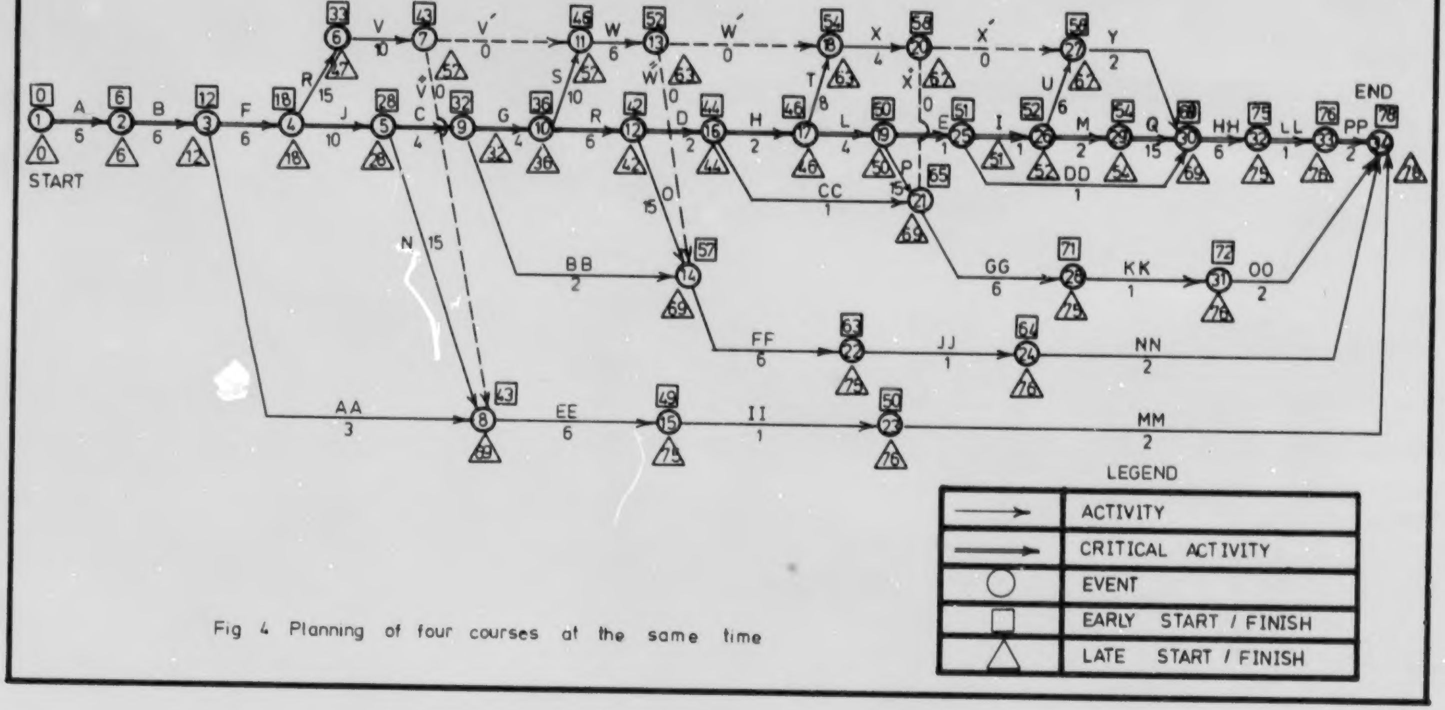
W 6
AA 1
DD 2
K 15
V 1
N 15
Q 10
Q' 0
Q'' 0
O 10
U 2
L 15
X 6
P 6
BB 1
EE 2
R 6
R' 0
R 0
S 4
LEGEND
ACTIVITY
CRITICAL ACTIVITY
EVENT
EARLY START / FINISH
LATE START / FINISH

Fig 3 Planning of three courses at the same time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END
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B 6
F 6
R 15
J 10
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V´ 0
C 4
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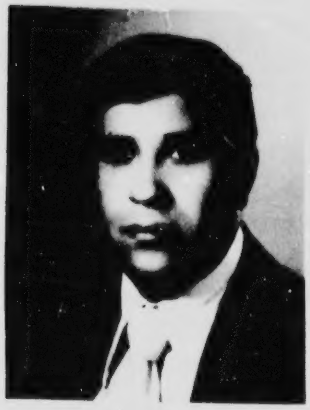
W 6
W´ 0
W1 0
D 2
O 15
BB 2
H 2
T 8
X 4
X´ 0
L 4
E 1
P 15
CC 1
I 1
U 6
Y 2
M 2
Q 15
DD 1
HH 6
LL 1
PP 2
GG 6
KK 1
OO 2
FF 6
JJ 1
NN 2
AA 3
EE 6
II 1
MM 2
LEGEND
ACTIVITY
CRITICAL ACTIVITY
EVENT
EARLY START / FINISH
LATE START / FINISH

Fig 4 Planning of four courses at the same time



DR. SABAH AL-NASSRI

Dr. Sabah Al-Nassri is a graduate of the University of Liverpool in U.K. from where he obtained his first engineering degree in 1968, and his Doctor of Philosophy degree with Hydraulics as major in 1971. He has held various positions of responsibility in the Universities of Baghdad and Technology in Iraq, and is now the Vice-President of the University of Technology. Dr. Al-Nassri has been involved in consulting work and is the Board Director of the "Associate" Consultant Engineers. He has published papers in the fields of Hydraulics and Engineering Education and is a pioneer in the planning of Continuing Education in his country. He is a member of the International Working Group on Continuing Education for Engineers and Technicians under UNESCO, and a member of Iraqi Engineering Society, ASCE, BCS and IAHR.

DR. MAHESH VARMA

Dr. Mahesh Varma was educated at Banaras Hindu University, India for his Bachelor's and at University of Roorkee, India for his Master's Degree. His Ph.D. Degree with Civil Engineering (Construction) as the major field was earned at Oklahoma State University, U.S.A. Dr. Varma has worked on the construction of some major river valley projects in India, and taught at University of Panjab and University of Roorkee in India. He holds the position of Professor in the Water Resources Development Training Center at Roorkee, and is presently assigned as Professor at University of Technology, Baghdad. For some time he was a Visiting Professor at Thailand's Chullongkorn University in Bangkok. Dr. Varma is a pioneering educator in the field of construction systems, and has published books and papers in the field.

SESSION 5C

CONTINUING ENGINEERING EDUCATION COSTS — HOW MUCH AND WHO SHOULD PAY?

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Rochester, New York

It is the purpose of this session to study the question of the costs associated with continuing engineering education programs. In the course of the discussions, we will look into not only the magnitude of the several costs associated with continuing education activities, but we will also address the equally important question of how those costs will be paid. For purposes of the early discussion at least, we will direct our attention to those continuing education programs of a nonacademic-credit nature offered on behalf of the engineering or technical personnel of business and industry. Such programming may be provided by the business or industry itself, by a university under contract, by a professional society, by the government, or by elements of the private sector who have begun to realize that continuing education is big business.

Perhaps the most obvious cost associated with continuing engineering education programs is that cost involved with the production and delivery of up-to-date and appropriate educational materials. Whether materials are prepared to serve a one time need of a single group of homogeneous students or designed to serve continuing needs of a wide range of students in different circumstances, a careful needs assessment is a first requirement. The next step is the preparation of appropriate instructional materials. These may be as simple as acquiring published written materials to accompany a course outline, or as elaborate as specially prepared audio-visual materials (movies, slides, video tapes, etc.) or programmed, self-paced computer learning modules. This step is likely to involve significant costs. Considerable time and effort may go into the training and preparation required of the instructor or instructors who will manage the continuing education program. Finally, there is the actual cost of delivery to the students or industry participants. Here we include the cost of distributed materials, the salaries of teaching personnel, and the other direct costs of putting on a given program. Since all educational programming should have a follow-up evaluation, we must include the very real costs of testing and evaluation needed to determine the effectiveness of a given program.

All of the costs delineated in the previous paragraph might be referred to as "direct" costs. For each one of these direct costs there is a less obvious, but just as real indirect cost or overhead - the cost of doing business. This indirect cost may vary from a small fraction of the direct cost to an amount well in excess of the direct costs. In any case, the indirect costs are substantial and must be included in a tally of the total costs for a continuing education program.

A variety of arrangements exist for the offering of continuing education programs in the business-industry sector and nowhere is there more variation apparent than in the matter of scheduling. Some programming is intense in that it is offered on a full-time basis over periods extending from one day to two weeks. Other programs are offered on a part-time basis for periods extending to ten or fifteen weeks with an occasional program that may be even longer. What is perhaps more important, at least on an economic basis, is on whose time the actual instruction takes place. Courses may be scheduled solely on company time, solely on the employee's time outside the normal working hours, or they may utilize time from both categories. Where company time is used for the continuing education programs, the lost time in terms of direct salaries and related overhead can be substantial. Such costs are sometimes referred to as "opportunity costs". For an elaborate continuing education program with extensive preparation, expensive faculty, an enrollment of twenty-five high level engineers and using forty hours of company time, the total bill, including opportunity costs, may exceed $100,000.00. The cost of such a potentially expensive program must be balanced against the anticipated benefits to be derived from the continuing education experience of the participants and the company. Looking at the question in another way, the cost of the continuing education program should not exceed the cost of not doing it in the first place - a cost that is real, though difficult if not impossible, to determine.

Beyond attempting to identify all of the direct and indirect costs associated with a particular continuing education venture, we should also address the question of who should bear those costs and if the cost is to be distributed among several parties, how it should be shared.

A well designed and administered continuing engineering education program will certainly benefit the company or business that sponsors such a program for its valued employees. As a result of continuing education programs, companies look forward to increased productivity, new products, better design, improved management and other technological innovations. For this reason, many companies have been more than willing to bear the full cost of such programming for their employees - even to the point of allowing particularly valuable employees to pursue such noncredit studies away from the plant or business site on company time and at full salary while away.

The sponsoring company or business is certainly not the only entity that benefits by having a more up-to-date and viable work force as a result of continuing education programs. The individual who participates in such programming has his or her own value enhanced through acquisition of new techniques and modern technologies, with resulting increased employability and heightened mobility. It can therefore be argued that the benefits to the individual are sufficient to justify his or her payment of at least a portion of the costs of the continuing education. It is not altogether uncommon for an employee who has just finished an extensive continuing education program in a particularly demanding new technology to find himself suddenly in a better job for a new employer.

Because of the mobility of high technology employees and bright and ambitious technical managers, it is arguable that the benefits of a broad scale continuing education program for technical and managerial personnel benefits the entire nation's economy and thus justifies government participation in the bearing of costs for such programming. In the United States, this concept has led to the support of continuing education programs for engineers and scientists by the National Science Foundation and, in some other countries, the use of tax dollars collected from business and industry for similar purposes.

No matter from which vantage point one studies the question of continuing engineering education, it is obvious that it is rapidly becoming a big business unto itself. It therefore behooves us to carefully understand the growing cost of this venture and make certain that we assess those costs in the proper places. Such is the subject for discussion today in this session.

Dr. Richard A. Kenyon

Dr. Richard A. Kenyon is Professor of Mechanical Engineering and Dean of the College of Engineering at Rochester Institute of Technology. Dr. Kenyon earned the B.M.E. Degree at Clarkson College of Technology, an M.S. Degree at Cornell University and the Ph.D. at Syracuse University. He currently serves the American Society of Mechanical Engineers as a Regional Vice President and was recently elected a Fellow of the Society. Dr. Kenyon has been involved in developing numerous continuing engineering education programs in industry during the last ten years.

SESSION 5D

STAFFING REQUIREMENTS FOR CONTINUING EDUCATION PROGRAMS

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Punjabi University, Patiala
Patiala, Punjab

Summary :

In view of the fast growing knowledge in engineering & technology, extension of knowledge to the community as a continuing process is an important third function of an engineering institution in addition to the well established two-fold functions of (i) conducting research and (ii) discovering and dissemination of knowledge.

The three-fold general functions of continuing education of engineers are (a) improvement of professional competence (b) training for management role and (c) training to face socio-political changes and to fulfil the desire for personal cultural advancement.

To fulfil these functions, an institution should organise a separate multi-disciplinary broad-based department of continuing education which will have its own faculty for instructions and research and will involve in its activities faculty members from other departments of the institution, from other institutions in addition to experts from the field.

An Advisory Committee, with the head of institution as its chairman, and membership consisting of head of the department of continuing education, a few members from other disciplines, members of the community having involvement in continuing education, should be constituted to guide the policies of the department. Handled properly, this activity will expand and turn into a major effort having a healthy effect on the entire education and research programme of the institution and making it more relevant to the needs of the society.

Introduction :

Once it is recognised that knowledge in engineering & technology, as in all other fields, is fast growing, a person once trained shall have to come back to be retrained to meet the challenge of changing needs. Engineering institutions can no longer confine their activities to the well-established two-fold functions of conducting research and discovering and dissemination of knowledge, but add a new vitally important third function of extension of knowledge, as a continuing process, to the community which is maintaining these institutions at a huge cost.

Continuing Education in Engineering Institutions :

The general functions, which continuing education for engineers must fulfil, may briefly be stated as under:

(a) Improvement of professional competence

(b) Training for management role

(c) Training to face socio-political changes and to fulfil desire for personal cultural advancement.

It need hardly be pointed out that engineering institutions have the necessary talent, equipment and infrastructure to fulfil the function under (a) & (b) above without much difficulty with the help of their own faculty and some experts from the field or other institutions specialised in management functions. As far as functions under (c) are concerned unless an institution itself has a very strong department of humanities and social sciences, the availability of internal resource personnel will only be marginal. Experts shall have to be mainly sought from the field or departments of social sciences in other institutions or universities.

Staffing of Department of Continuing Education :

The question of staffing and consequent financial implications will depend upon the mode or organisation that is adopted. To start with, the function could be assigned to one of the existing departments, which may be comparatively lightly loaded. In the alternative, one of the senior staff members of the institution could be partly spared from his normal duties and could be given the additional duties of organising the programme of continuing education in the institute, with secretarial help. In an institution, where the activity is just beginning, it may be important that the head of the institution gives this activity his personal patronage. His pre-eminent position would not only help in resolving administrative problems, and attract local faculty interest, but also help in establishing a better liaison between the institution and the community. As the activity develops, a separate department of continuing education shall have to be started to organise the programme properly.

The organisation and staffing pattern of the department of continuing education in an engineering institute shall be some-what different from any other department, which runs as an autonomous unit, subject to over-riding controls of the head of the institution and administrative bodies. No-one, except the members of the department is concerned with the way the department functions. It has to concern itself with the problems of instructions and research within its own well-defined limits, consulting the other departments only on inter-departmental policy matters. The department of continuing education, while conforming to the general pattern of other departments, has to have some-what of a dual structure with its members engaged in the work of instructions and research besides some members of the other departments also taking part in the activities. The organisation of the department will thus be more elaborate and broad-based. It may better be described as 'multi-disciplinary department'.

Advisory Committee for Department of Continuing Education :

In addition to the other departments, the general community shall have to be involved into the work of the department of continuing education in a positive and meaningful way. The best way of doing it is to constitute an Advisory Committee with the head of the institution as its chairman and membership consisting of a few other staff members connected with various disciplines including head of the department of continuing education, and several members of the community connected with industry, business, trade unions, public affairs, voluntary organisations and such other bodies which have a direct involvement in continuing education. As the chairman of the Advisory Committee, the head of the institution would combine in himself a double role. On the one hand, he represents the academic community of the institute, and on the other hand, being an important member of the community, he would be able to secure its support and good will.

Financial Administration of Department of Continuing Education :

Now coming to the question of financial administration of the department of continuing education, to start with, funds have to be found from within the institute. A few persons have to be employed to plan and organise the work of the department with modest administrative initial expenditure. Of course. when the various activities of the department get going, the expenses begin to mount. In any city or town with developing industrial and commercial activities, where a large number of engineers and technicians would need retraining to improve their skills and prospects, and would be prepared to pay for this educational opportunity, such activities become self-sustaining. The Advisory Committee should exercise judgement and guide to get such programmes started as do not impose burden on the resources of the institute.

Continuing Education at Thapar Institute :

At the Thapar Institute of Engineering & Technology, we have two wings :

i) College, having programmes for engineers leading to Bachelor, Master and Doctor Degrees in Civil, Electrical, Electronics & Electrical Communication & Mechanical Engineering,

ii) Polytechnic with courses

leading to Diploma in Civil, Electrical and Mechanical Engineering for middle level technicians.

At both these wings we have been running continuity education programmes.

At the Polytechnic, trained craftsmen with proper educational qualifications are given evening courses to obtain a diploma in engineering to become middle-level technicians. There are evening classes for diploma holders to enable them to pass the examination for Associate Membership of Institution of Engineers (India). This Associate Membership is considered equivalent to Bachelors'Degree for employment purposes. We are in the process of starting a Condensed Bachelors Degree Course for Diploma holders both on regular and part-time basis. Since 1971, we have been having regular as well as part-time Masters Degree programme for Bachelor Degree holders.

Patiala is a medium sized town with a population of about 1,80,000 with head-quarters of a number of Government departments such as Public Works Department, Electricity Board of the Punjab State. Government jobs and promotions are given on the basis of educational qualifications. Therefore, the above programmes of continuing education are such as to lead to improvement in educational qualifications. They are run with the help of faculty of the institute and some experts from the field/industry. Industrial growth in the neighbourhood of Patiala has not yet come to a stage where short-time specialized courses would be in demand. However, a few courses of this type e.g Concrete Technology & Prestressed Concrete Design, Bridge Design, Design of water-tanks and other storage structures, special problems in foundation design, CPM & PERT in Civil Engineering Construction, Rural Engineering have been run when the need for such courses was felt. All these activities of continuing education are very popular and almost self-sustaining, with only marginal expenditure on the part of the institute. Also summer/winter schools on advanced subjects such as "Summer School in Planning, Management & Control of Modern Integrated Power System, Optimization Techniques & their Applications to Electric Utility Problems, Design, Analysis and Optimization of Heat Exchangers and Analysis, Design & Performance of Turbo-machines have also been held for up-dating the knowledge of the teachers from all over the country under the sponsorship of Indian Society for Technical Education. As the time passes, activities in the field of continuing education would be expanded.

Flexibility in Continuing Education :

In the end, it may be pointed out, that no specific guide-lines can be laid down for staffing pattern for continuing education programmes in an engineering institute. Depending upon the need of the community, the programme shall have to incorporate flexibility to be able to offer short-term/full-term or part-time/full-time or credit/non-credit or on campus/off campus courses. Faculty could be drawn from within the institution or from other institutions or experts from the field. To make the programme really purposeful, adaptability and dedication shall have to be the watch-words. Once started even in a small way, this activity, with proper handling, will turn into a major effort impinging upon the entire educational programme of the institution. Members of the faculty will learn from contact and dialogue with their peers in the field. In fact, the emphasis will, in due course, shift from teaching to learning. This will have a very healthy effect on normal teaching and research work in the institute making these activities more and more relevant to the actual needs of the industry and society. The present complaint of institutions being insular and elitist in their out-look will, in due course, disappear.

JAIN, MOTI LAL

Jain, Moti Lal; B.Sc(E&M), MEE, DSc; b, January 1, 1922 Ambala Cantt, w Pushpa, One s and Two d; Educ B.H Univ, Cornell Univ, Harvard Univ; Prof Elec. Engg & Director, H.T Laboratory, Jadavpur Univ 1949-56; Asstt Production Manager, National Insulated Cable Co 1956-58, Prof & Head, Elec. Dept, Thapar Inst. of Engg & Technology Patiala 1958-67. UNESCO Expert in High Tension, Advisor to Faculty of Technology, University of Havana (Cuba) 1967-71, Principal/Director, 1971- Dean, Faculty of Engg, Punjabi Univ, Patiala; Sr Member, Instn of Elec. & Electronics Engrs (USA) Fellow, Instn of Engineers(India); Chairman, Northern Zone & National Vice-Chairman 1972-73 & 1973-74; Life Member, Indian Soc for Technical Education; publs - D.C Machines (1958); Research Papers in National & International Journals - Present interest : Energy & Engineering Education. Address : Thapar Institute of Engineering & Technology, Patiala.

SESSION 5E

EVALUATION OF CONTINUING EDUCATION PROGRAMS

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Evaluation of CE Programs

Evaluation of the effectiveness of continuing education activities is an important and necessary function of the program director. Undergraduate and graduate engineering degree programs are evaluated in their entirety. However, because most engineers do not take a series of courses in a continuing education program, but participants in one, two or three day short courses concerning a particular subject, each individual course must of necessity be evaluated for its effectiveness. This is more difficult than it sounds.

Ideally the evaluation process for each course must answer some of the following questions:

- Was the material relevent to the needs of the audience to whom it was presented?
- Was the material presented utilizing accepted adult teaching methodologies?
- Were the course objectives met within the scheduled time period?
- Was there a recognizable positive change in job performance once the participant returned to the job site?
- Did the course participant derive from the program what they thought they expected when they decided to attend the course?
- Was there an adequate balance of theoretical and applied material presented by the instructor to bridge the very difficult gap between theory and engineering practice?
- Was the program environment matched to the goals and objectives of the program given?
- Did the instructor understand the necessity of presenting the educational material in an adult learning environment to insure its effectiveness? How did he demonstrate this?
- Was the program cost-effective in terms of time, energy, and resources expended from a learner-teacher point of view?

Looking at current evaluation procedures used in continuing education activities, one sees only partial results for each of the above. Most evaluations are highly subjective and rely heavily on opinions and reaction to program experiences that are not necessarily directly associated with program content. Education is hard work and requires that continuing education participants apply themselves outside the formal learning environment. With the pressing requirements of the day to day job responsibilities this is often difficult to achieve.

Evaluation of the effectiveness of any program in the best possible environment is difficult. Industry wants the individual program to change job performance. The engineers hope the material learned will enhance their career opportunities. The institution offering the program hopes that it is of educational value, that it enhances their image, and at a minimum breaks even cost-wise.

When should one evaluate a program? Immediately following the program or at some time later when the program participant returns to the job setting where hopefully some behavior has been modified? Below is a letter received from a participant one year after the program was held. Certainly most continuing education directors would conclude this was a highly successful program for this particular participant. General evaluation results taken at the time of presentation, however, seemed to indicate that it was an average program.

Thus the dilemna! We hope to answer some of these questions during this session and perhaps come up with some model program evaluation procedures that continuing education directors might follow to improve their course offerings.

A. M. ZAHOORUL HUQ

Born 1923. B.Sc.Hons,Physics and M.Sc. Applied Physics from Calcutta University. M.S.(E.E.),Columbia Univ.N.Y.,1951; Ph.D. from London Univ.,1962. Fellow, Inst. of Engineers,Bangladesh. Professor and Head, E.E.Dept.,Bangladesh Univ. of Engineering and Tech. Dean,Faculty of Engineering 1972-74. Member,National Education Commission 1972-74.

Author of:Introduction to Electrical Engineering(in Bengali language), and five other Bengali books,one of which was awarded a Unesco prize,and another the National Bank Book prize.

Attended 9th World Energy Conference, Detroit,1974 to present a paper; also Vice-Chairman,Unesco Seminar on Education -Industry Cooperation in Engineering Education, Research and Training, at Shiraz, Iran, 1977.

Married; one son and one daughter.

SESSION 6A

GROUP I

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It seems that the Program Committee purposely did not place the topics of this session under one common heading because the titles of the papers submitted look - at the first instance- rather diversified.

At a closer look, however, one can say that the subjects to be presented highlight actual Third World needs. To avoid a misunderstanding: The topics are of equal interest in all parts of the world, but in industrialized countries continuing training of engineers, working for instance in plant or sanitary inspection, is already part of the educational establishment, wheras in many industrializing countries such a kind of "work and learn" - system only exists since a few years or has still to be introduced.

The majority of engineers and research workers who will speak to the audience this morning are coming from or have been working in developing countries. Thus we have the great advantage of getting first hand information on the often difficult and complex problems involved. This will - I am convinced - also lead to a very lively and fruitful discussion.

In connection with the topics dealt with in this session, some aspects of post-University education should be taken into consideration.

Firstly some Third World countries undergo industrialization and environmental improvements with high speed. This leads in most cases to a shortage of qualified staff. Built-up crash courses, evening schools, training on the job for previously less qualified or specialized engineers are ways and means to bridge the gap and to reach certain minimum standards. We can say that on the long run the standard of industrial production depends decisively on the capability and thoroughness of supervising engineering personnel.

Secondly it is quite natural that those who need to spend scarce foreign currency on process equipment and other industrial goods will buy the latest and best available on the world market. Consequently, those engineers who have to inspect this equipment in operation and have to attest safety, need corresponding additional instruction, new knowledge and skill. In this case continuing education is a must. Joint programs arranged between supplier and buyer - also subject of this session - are particularly helpful.

The third aspect arises from the fact that many engineers born in developing countries acquired their education in the United States or Europe. Returning home, i.e. in most of the cases to the Tropics, they have to be familiarized there with environment-related engineering problems. The adaption of modern technologies to the unconventional, sometimes extreme conditions in developing countries remains a permanent task for continuing engineering education.

Finally it should be mentioned that under the aspects outlined before, the recruitment of teaching staff deserves particular attention. Even highly specialized senior engineers lack qualification if they are unable to motivate participants or if they cannot establish a close link between the problems in question and those who are to solve these problems.

Continuing education as part of adult education has its own principles and obeys own rules. Although this fact is subject to a separate session the speakers this morning will without doubt touch upon these rules and experiences made from their particular viewpoint.

JOHANN LUDWIG ATROPS

Born in 1921. Dipl. Ing. 1949, Dr.-Ing.1953 Civil Engineer (Steel and Timber Structures, Welding Science). Employed 1949 - 1966 by Fried.Krupp AG, several engineer. Firms and College of Building Sciences (Lecturer, Senior Lecturer). 1966 appointed to the BP-Chair in Steel Structures and Process Equipment Design, University of the West Indies, Trinidad. Research semester at the University of Santa Catarina, Brazil. 1971 elected Rector of the Fachhochschule Koln (9000 Students), a new type of Teaching and Research Institution of Tertiary Level.

1973/74 UNESCO - Adviser in Indonesia, 197t in the Sudan.

Since 1976 Director, Postgraduate Teaching and Research Institute for Technology in the Tropics, Cologne, West Germany.

INDUSTRIAL INSTRUMENTATION TRAINING COURSES OF TECHNOLOGICAL PROMOTION ASSOCIATION (THAI-JAPAN)

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Summary-Several Industrial instrumentation training courses for engineers and technicians have been carried out in recent years at the Technological Promotion Association (Thai-Japan) with good response from the industry circle. The success of these courses are attributed to the right response of the program of the course to the needs of industry based on years of experiences of the members of Industrial Instrumentation Project working in industry, careful selection of trainees, experienced industry-oriented instructors, and practical training and demonstrations.

Background test before and achievement test after the course have shown that the trainees have improved and gained their technical knowledges much from the course. Questionaires and frequent visits to the engineers and technicians who completed these courses and back to their work in industry have produced helpful information for the improvement of the course. Some attitudes of engineers and technicians working in industry towards continuing engineering education are presented.

Introduction

The Technological Promotion Association (TPA), a non-profit, non-political organization, was officially registered on January 24, 1973. Its establishment came through the efforts of members of Asian Bunka Kaikan (A.B.K.) Alumni Association, with the co-operation and support of Mr. Goichi Hozumi, the Chief Director of both A.B.K. headquarter in Tokyo and Japan-Thailand Economic Cooperation Society (JTECS).

At present, the Association has 371 ordinary members, 226 extraordinary members, and 29 juristic person members. This figure indicates an increase in membership approximately three times that of the first year of its establishment. The expense of TPA is mainly covered by contributions from the Japanese Government and partially by private Japanese firms which are members of JTECS in Tokyo. The budget is allocated upon the request of TPA in the form of projects. Due to rapid expansion of its activities in promoting technology, TPA has increased its budget from approximately 120,000 U.S. dollars in 1973 to approximately 220,000 U.S. dollars in 1978. Though it is mostly financed by the Japanese Government, the management is run independently by Thai personnel.

The Association is actively implementing its various programmes of helping Thai Industrial establishments to cope with their problems in industrial technology, such as quality control, maintenance, instrumentation, safety and even in breaking up the language barrier especially Japanese to Thai and vice versa. The TPA has now five important projects. They are the Industrial Technology Support Project responsible for the distribution of technical know-how by publishing books regarding technology; the Industrial Instrumentation Project responsible for training the local industrialists to keep pace with the advancement of process instrumentation technology; the Seminar Project aimed at arranging seminars and training sessions to increase the level of technical knowledge among the Thais; the Language Instruction Project responsible for teaching Thai and Japanese languages; and the Journal Project responsible for issuing a bi-monthly journal to disseminate information bearing on new development including news of technological advancements in various aspects.

The present office of TPA, a three-storey new building located at 5-7 Sukumvit 29, Bangkok, is well-equipped with every facility necessary for implementing the TPA's policies and fulfilling its objectives.

The objectives of the Association are to promote and to support the advancement of technology among the members and the general public, to hold seminars and training sessions and to publish books as well as documents concerned with technology, to lend books and documents, to open training courses in languages , to issue periodicals of the Association, and to cooperate with other institutions of similar objectives.

It is interesting to note that TPA at the time of its establishment apparently does not include any clause of continuing education in its objectives. However, practically, in achieving its objectives as to promote the development of technology and to foster the growth of industry, today TPA has automatically functioned its important roles as the biggest private institution in promoting continuing engineering education for engineers and technicians in Thailand.

Some Attitudes Concerning Continuing Education

Information about the attitudes of engineers and technicians working in industry towards continuing engineering education is essential for planning the educational modes of TPA. The TPA, through the Industrial Instrumentation Project (IIP) sub-committee, has conducted series of survey from engineers and technicians attending the training courses. Using a questionaire modified from that issued by IEEE,[1] the survey revealed some valuable information showing certain characteristics which are perhaps unique for Thailand.

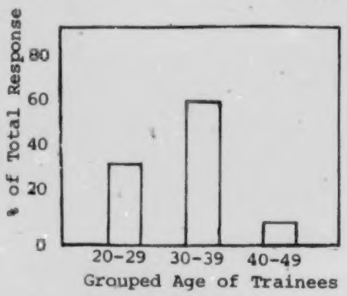

Fig. 1. Age distribution of trainees.

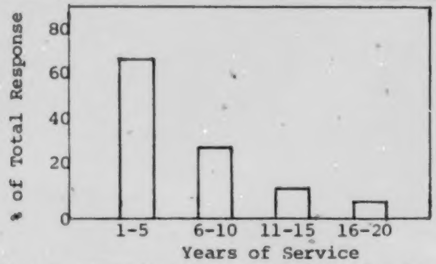

Fig. 2. Distribution of lengths of careers of trainees.

Figs. 1 and 2 show the age distribution and years of service of training engineers and technicians. It can be seen that there are 92 percent of populations at the age level below 40, with career lengths varying from 1 to 10 years. The survey also revealed that 55 percent and 30 percent of trainees attended the training course of TPA the first time and the second time.

TABLE I
How Important Do You Feel Training Course Is To The Development of Your Ability in Job Performance?

Very Important	42 %
Important	55 %
Of Little Importance	3 %
Unimportant	0 %

Table I shows that more than 90 percent of the trainees considered training course to be either "very important" or "important" to their job performance.

Table II shows the type of recent educational activity of those surveyed. In our case, on-job courses provided by the individual's employers are the most-used educational mode, followed, perhaps surprisingly, by self-study from library, handbook and operating instruction book and third, by self-study courses and fourth, by other professional courses. College courses ranked the fifth. This is because the university extension programs in Thailand have not yet been extended to include instrumentation course or have not been widely accepted for their poor response to the industrial needs by teaching technology which is no longer relevant, using procedures, techniques and equipment that have become outdated.[2] It is also found that engineers and technicians working in larger industrial corporations receive more training than those working in even the state enterprises.

Table III shows the rank order in terms of value of the various educational modes used. Technical publications and on-job seminars are found most useful, followed closely by short courses and self-study. Again university course is not so widely accepted here.

In addition, the survey also revealed in order of importance the next courses the trainees desire to study. However, the information obtained depends heavily on the nature of the training course, the educational background, and the career of those surveyed.

TABLE II
Recent Educational Activity of Those Surveyed

	Percent of Educational Activity
Employer's Training Courses	51.9
Self-Study Courses	25.9
College Courses	11.1
No Current Educational Activity	3.7
Other Professional Courses	18.5
Independent Organization Courses	14.8
Other (Self-Study from Library, Handbook, and Instruction Book)	48.1

TABLE III
Rank Order of Educational Mode in Terms of Value

	Value Figure of Merit
On-job Seminars	20.5
Technical Publications	22.2
University Courses	11.6
Job Rotation	10.6
Self-Study	14.1
Short Courses	19.0
Other (Exchange of Experience)	2.0

Programs of Training Courses

Since the establishment of the Industrial Instrumentation Project in 1977, several training courses on industrial instrumentation, process control, and safety have been conducted. They are shown in Table IV with number of attendants and those who completed the course. Some of these courses are fundamental courses paving the technical know-how bases for engineers and technicians such as courses on Fundamental Electronics

TABLE IV
Training Courses Held at The TPA
September 1977 - October 1978

Courses	Number of Trainees	Completed
1. Fundamental Electronics for Instrumentation	40	32
2. Fundamental Electronics for Instrumentation	35	28
3. Basic Instrumentation	43	34
4. Automatic Boiler Control	45	37
5. Electrical Protective System	28	26
6. Basic Instrumentation	36	36
7. Temperature Measurement and Control System	25	20
8. Fundamental Electronics for Instrumentation	38	35
9. Flow Measurement and Control System	35	28

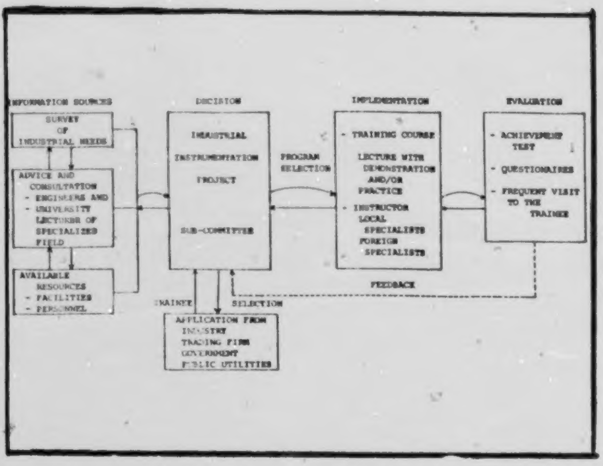
INFORMATION SOURCES
SURVEY OF INDUSTRIAL NEEDS
ADVICE AND CONSULTATION
- ENGINEERS AND
- UNIVERSITY LECTURER OF SPECIALIZED FIELD
AVAILABLE RESOURCES
- FACILITIES
- PERSONNEL
DECISION
INDUSTRIAL INSTRUMENTATION PROJECT
SUB-COMMITTEE
PROGRAM SELECTION
IMPLEMENTATION
- TRAINING COURSE
LECTURE WITH DEMONSTRATION AND/OR PRACTICE
- INSTRUCTOR
LOCAL SPECIALISTS
FOREIGN SPECIALISTS
EVALUATION
- ACHIEVEMENT TEST
- QUESTIONAIRES
- FREQUENT VISIT TO THE TRAINEE
FEEDBACK
TRAINEE
SELECTION
APPLICATION FROM
INDUSTRY
TRADING FIRM
GOVERNMENT
PUBLIC UTILITIES

Fig. 3. A Model of Need Analysis and Evaluation.

for Instrumentation and Basic Instrumentation. Others are designed for engineers working in industry for improving their technical know-how on the operation, maintenance, and safety of industrial instruments. The following will discuss how programs of training course are determined and the related topics.

Need Analysis

Knowing the needs of industry is of utmost importance to IIP to fulfil the objectives of TPA in fostering the growth of industry by providing the required training to engineers and mechanics. Analysis of the needs of industry in what kind of instrumentation training to be held was based partly on years of experience of our IIP members working in industry, in instrument selling company, and in university, through series of group discussions and careful consideration. However, care is exercised to avoid our presumption and feelings from leading us to decide wrongly the needs of industry. This can be achieved by also integrating into our decision process the information obtained from the actual survey of industrial needs conducted as well as from seeking the advice and consultation from both the experienced engineers working in industry and the university lecturers specializing in industrial instrumentation and course design. Finally, the available resources such as training facilities and instructor for the training course proposed are also taken into consideration in deciding the sequence and time schedule of the training courses to be arranged at the beginning of the fiscal year which is April every year. This mechanism of need analysis is shown in Fig. 3.

Survey of the needs of industry was conducted from engineers and mechanics attending our industrial instrumentation training courses in order to save the surveying expenses and to get better and keener responses. The information revealed by the survey is invaluable for decision making. For instance, from the course on Flow Measurement and Control System surveyed, the next courses proposed by the trainees to be arranged in order of popularity are control system, pneumatic and electric controllers, pressure measurement and control, temperature measurement and control, and level measurement and control etc. for which we had not expected before that control system, though important for understanding the industrial process, should have gained so much interest from the trainees. Hence, whether the program of the training course meets the needs of industry or not, it depends on careful interpretation of the collected information and harmonious interaction in judgement between experiences of the IIP members and the information collected.

Description of the Program

The program of the IIP aimed at raising the standard of technical know-how of process instrumentation, is a nationwide effort involving the co-operation not only from government agencies, public utilities authorities, universities in Bangkok, but also universities, colleges, and vocational schools upcountry as well as foreign instrument companies such as Yokogawa, Hokushin, and Meidensha etc.

The idea of the program is to hold training courses on industrial instrumentation with emphasis on disseminating the process instrumentation technology and knowledge on the related field in newly-found electronic components to the trainees through lecture with demonstration or practice in the 100,000 U.S. dollar instrumentation laboratory of TPA. The unique characteristics of our program are an emphasis on translating theory into practice, the straight-to-the-point applications to process control and process instrumentation technology such as design criterion, trouble shooting, or improvement of control system, and an amicable atmosphere created in the lecture-room to facilitate the exchange of views and experiences in instrumentation among the trainees and the industry-oriented instructors. In this respect, careful selection of applicants according to their experiences and qualifications set by the curriculum as well as the distribution of number of trainees are important factors to promote this atmosphere. Also incorporated in the lecture is a 15 minute problem solving discussion at the end of each training period and 2 hour conclusion at the end of the course. In the Basic Instrumentation course, two hours are given for questioning and problem-solving discussion to trainees with all instructors present. This will help the trainees understand the whole text of lecture and gain practical know-how to solve their own problems in the industry. Also in the Fundamental Electronics for Instrumentation course, two hours are given as conclusion which integrates all the electronic components and systems into one instrumentation system with clear explanations on the operating principles of the system. As for training courses which require very specialized instructors such as Temperature Measurement and Control, Flow Measurement and Control, and Boiler, foreign specialists are requested through the Japanese co-ordinator at JTECS in Tokyo in the form of short course (18 hours) upon a submission of course description, duration of time required, participants' qualification, and teaching language. However, it is often difficult to find a suitable instructor to meet the requirements of the course description because foreign specialist usually knows his work and the closely related topic quite well but is unable to go into details the other topics mentioned in the course description. In addition, there is also a problem of language barrier.

The Industrial Instrumentation Training courses are divided into long and short courses. The long course designed for understanding the basic principles and theory, takes more than 30 hours and is usually arranged in the evening from 6 p.m. to 8 p.m. in order not to interrupt the working time of the participants. While the short course usually takes 3 consecutive week-days starting from 9 a.m. to 4.30 p.m.. This will provide intensive study on a certain topic. In designing the content of the course, every possible care is taken to ensure the program is attractive for the trainees. As a result, response from the industry sector is so great that, sometimes, compels us to turn down many applicants especially from the same industry in order to keep the number of participants within the limit of 30 persons to assure high quality in the process of technology transfer. From Table IV, it can be seen that although the Fundamental Electronics for Instrumentation and Basic Instrumentation courses have been arranged several times, they are still flooded with excessive applications.

Costs

The training program of IIP is mainly funded by the Japanese government through JTECS in Tokyo upon the request of TPA in the form of training projects. However, participants of the training course is also charged at a member rate of approximately 25 U.S. dollars and a non-member rate of 30 U.S. dollars for attending the long course with local instructors and the short course with foreign instructor. For the short course with local instructors, the rate is nearly halved. This fee income covering only about 30 percent of the expenses of a training course with local instructors, is used for paying coffee break, lunch if any, caretakers, and any items not included in the budget from JTECS. The remain is allocated for holding special seminars and training sessions other than planned, and for future expansion of TPA.

Without the financial support from the Japanese government, IIP would have never been so successful in operating its training course with so many expensive sets of industrial instruments totalling nearly 100,000 U.S. dollars, with plentiful teaching materials for demonstration, and with high honorarium to be paid to local and foreign experts as instructors. Though recently there has been a trend calling for self reliance from the members of TPA, but the solution is not yet found.

Enrollment

Enrollment in the training courses of IIP is considered to be one of the most important factors contributing to the success of the course. Qualifications of the applicants for the training course require mechanics having 3 years of experience in industrial instrumentation or technician with diploma and engineers having the knowledge of basic process instrumentation and experience in general industry both in production and maintenance, depending on the level of the course. The former is usually required for the basic courses such as Fundamental Electronics for Instrumentation and Basic Instrumentation etc., and the latter for the advanced courses such as Flow Measurement and Control System and Temperature Measurement and Control System etc.. In selection of the applicants, qualifications, distribution of applicant, and career are used as the main criteria. Evidence has shown that these criteria are workable. For example, from the backgound tests of two groups of trainees from two Fundamental Electronics for Instrumentation courses, although the first group consisting of the well-selected technicians who met all the qualifications prescribed, obtained an average of only 40.4 points out of 100 points; while the second group consisting of mostly mechanical engineers, industrial engineers, and some mechanics under the qualifications prescribed, obtained an average of 71.2 points out of 100, the achivement test at the end of the course has shown that the first group obtained an average of 43 points out of 100 while the second group obtained an average of only 41.4 points. This was due to lack of interest and motivation for learning from the second group which could be observed after the elapse of several lecture periods. Concentration of trainees from one industrial corporation in a training course would also spoil the atmosphere of mutual exchange of experiences among the participants. It is also found from the survey that the age distribution of trainees between 20 and 29 years is 33 percent, between 30 and 39 years is 59 percent and only 8 percent between 40 and 49 years.

Evaluation

At the start of the training course, background test is used to measure the level of basic technical knowledge of engineers and technicians joining the course. Before issuing the background test paper, the objectives of the test must be explained clearly and persuasively so that no objection would be raised against the test. The result of the test revealed that more than 80 percent of the participants gave good cooperation in answering the background test paper. The result of the background test was then compared with that of the achievement test. The achievement test was given 20 minutes and was more difficult than the background test. The result showed that the trainees have improved and gained their technical knowledges much from the course. It also showed that enrollment has great relationship with the success of the course.

At the end of the course, each trainee was requested to make a list of items he expected to learn from the course and what he has actually learned from the course. The result revealed that about 70 percent of what the participant expected to learn was actually learned. Comments on the course content, the teaching method, demonstration, and the teaching materials were fedback directly to the instructor through friendly mixture with the participants himself during the coffee break or through the co-ordinator of the course.

A questionaire in tabulated form with items about the length of lecture time, the ease to read the lecture note, the teaching method, the teaching equipment, the lecture content, and the ease to follow the instruction in vertical, and in horizon with topics of the course followed by the name of instructor in bracket, is given to each trainee to evaluate. The result of evaluation about the instructor performance revealed that most of the instructors have had good performance, except some industry-oriented instructors with teaching experience.

Frequent visits to engineers and technicians who has completed the course by some of our IIP members revealed that technicians who have completed the course can now function their instrumentation work both theorectically and practically well. Some of the technicians have already translated theory into practice and even into production. For example, one of the trainees in the FundamentalElectronics for Instrumentation course has already manufactured the voltage regulator he learned from the course at his own factory for selling in the market. Others have corrected their mispractice in instrumentation.

Indicators

Many indicators are used to determine the success of the program. One indicator is the response in application to our training course. As shown in Table IV, participants in most of the training courses held at TPA are more than the limit of 30 persons. In some courses, the demand is so great that though the courses have been held several times, they were still flooded with excessive applications. It is required that attendance should be at least 80 percent in order to complete the course. From Table IV, it can be seen that the number of trainees who have completed the training courses, are more than 80 percent of the total participants. This has strong correlation with the success of the course.[3] Indicators showing the effectiveness of the program can be identified from the actual spending of the budget of the Industrial Instrumentation Project as well as from the increase in number of training courses. Actual spending of the budget of IIP in 1977 was only about 50 percent of the budget granted which was approximately 56,900 U.S. dollars. While this year it is expected to spend more than 80 percent of the budget granted. This figure reflects an increase in the ability of budget spending and management over 1977 about twice.

Conclusion

Several industrial instrumentation training courses for engineers and technicians have been carried out at the Technological Promotion Association in recent years as part of the program to promote the development of technology and to help in the development of Thai industry. While the outcome and impact of these courses on industry can not be immediately evaluated, the success of these courses are attributed to the right response of the program of the course to the needs of industry based on our appropriate need analysis (an outcome of harmonious interaction in judgment between years of experience working in industry of our Industrial Instrumentation Project members and the surveyed information on the needs of industry), careful selection of trainees, experienced industry-oriented instructors, and practical training and demonstrations. In-class demonstration, problem-solving discussion, and conclusion with all instructors of the course present, adopted in our training courses, are very helpful for the participants to solve their problems and to improve their work.

Background test and achievement test conducted at the beginning and the end of the course, have so far received no objection from the participants and are used to evaluate the effectiveness in teaching of the the course. Information gathered from questionaires and frequent visits to engineers and technicians who completed the course has added to the improvement of the course.

Today the Technological Promotion Association has emerged as Thailand's biggest private institution in promoting continuing engineering education. In future, for the growth of industry, more activities concerning continuing engineering education are anticipated, and educational institutions should play more important roles in this field.

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PRASIT PRAPINMONGKOLKARN, Ph.D.

Prasit Prapinmongkolkarn was born in Bangkok, Thailand, on August 23, 1947. He received the B.Eng. degree in electrical engineering from Chulalongkorn University, Thailand, in 1970, and obtained the M.Eng. and Ph.D. degrees in communication engineering from Osaka University, Japan, in 1973, and 1976, respectively, under the Japanese Government Scholarship Program.

Since 1977 he has been an Assistant Professor of the Department of Electrical Engineering at Chulalongkorn University, and also a subcommittee member of the Industrial Instrumentation Project at the Technological Promotion Association (Thai-Japan) designing training courses for engineers and technicians from industry. At the same time he has been a National Computer Subcommittee member responsible for evaluating the computer project and computer network design. He is currently on the editorial board of the Computer Journal of Thailand and also a member of IEEE.

His current interests include communication systems, data communication and the continuing education of engineer and technicians.

APPROPRIATE EDUCATION FOR NIGERIAN ENGINEERS

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Summary

The paper discusses an educational program that was conducted for a group of Nigerian electrical engineers for a two-year period at the author's institution. The experiences and insights gained from the project are valuable in planning and operating educational programs for engineers from any of the less-developed countries. Specific details of the Nigerian educational system, and the different phases of the project are presented, as well as some comments regarding the planning of future programs.

1. Introduction

The paper presents the experiences and insights gained by the author in a project for the training of a group of Nigerian electrical engineers. During the different phases of the project, a great deal was learned about the Nigerian educational system, the engineering curriculum, the student-teacher relationships and the factors that influence the planning and operation of an educational program for Nigerian engineers.

It is felt that these experiences and lessons learned therefrom would be of some benefit to those who expect to be involved in educational programs for engineers from Nigeria or, for that matter, any country in the Third World. Even though this project dealt only with electrical engineers, the comments and ideas presented here should apply equally well to any other engineering specialty.

2. Introduction to the Project

The project was funded by an American Corporation which was setting up an extensive communication system in Nigeria. The project itself began in November 1976 but the initial negotiations started in early 1976. The project was completed in August 1978.

2.1 Project Objectives

The original aim of the project was to provide a special training in electronics and communication for a period of twelve to eighteen months to a group of Nigerian engineers who would be working on the communication system being developed and installed in Nigeria. However, as the preliminary discussions progressed, it became evident that there was a strong desire for the acquisition of bona fide credentials in the form of a B.S. or an M.S. degree from an American university. The degree from an American university was valuable both as a status symbol and as a key to promotions and better jobs in the future.

Consequently, the project was modified so as to provide the special training as originally planned as well as an opportunity to pursue a degree program subject to the student's educational qualifications. As will be discussed later, six of the participants were able to earn the M.S. degree in Electrical Engineering by the end of the project.

2.2 The Students in the Project

There were fifteen engineers in the group. Their educational background varied rather widely. Four had a B.S. degree in Electrical Engineering, three of which were from Nigerian Universities and one from a technological institute in England. Six of the others had been through an intensive twenty-four month program at the University of Ife in Nigeria, which covered the same electrical engineering subjects normally covered in their regular B.S. degree program. The remaining people had miscellaneous technical backgrounds acquired primarily through special non-degree type courses and programs in Nigeria and other countries, e.g. England, India and Pakistan.

Before continuing the discussion of the project in detail, it is necessary to become somewhat familiar with the educational system in Nigeria.

3. The Nigerian Educational System

The details of the educational system (number of years and curricula) as well as those non-curricular aspects of that system which play an important part in the planning and operation of an educational program for persons educated in Nigeria deserve some detailed consideration.

3.1 The Engineering Educational Program in Nigeria

A student wishing to enter the engineering program at a University in Nigeria needs a General Certificate of Education (GCE), which is obtained by passing the equivalent of the Senior Cambridge Examinations of England. In some cases (those who have the GCE-Ordinary level and passed an entrance examination), there is one year of pre-university courses before starting on the degree program. Those with the GCE-Advanced level can enter the degree program directly. It appears that those with the advanced level GCE have a background roughly similar to the high school graduate in the U.S.

The engineering degree program is of three years duration for the "pass" degree and four years duration for the "honors" degree. The engineering curricula are of the traditional type with emphasis on classical subjects. The laboratory courses tend to be more of the verificatory type than design-oriented.

There are also engineering technology programs offered by technical colleges or colleges of technology. These are lower level programs with admission requirements much lower than those for a university degree program. In fact, if a student earns a diploma in engineering technology and then wishes to obtain a B.S. degree in engineering at a university, he will have to start at the second year of a three-year program.

3.2 Important Aspects of the Educational System

There are several aspects of the educational system in Nigeria which are of great importance in the planning, organization and execution of any engineering educational programs for Nigerians. They are: (1) the methods of instruction and evaluation and the student-teacher relationships; (2) the lack of emphasis on the practical and design aspects of engineering; and (3) the lag in technology in the country and in the university programs.

Each of these points has to be examined in some detail, for they provide the necessary insight into the makeup and attitudes of the Nigerian engineer towards any educational program.

3.2.1 Method of Instruction and Evaluation and Student-Teacher Relationships: The methods of instruction and evaluation of the student are patterned after the so-called British system and are similar to what is found in most of the less-developed countries.

The professor delivers lectures and his primary concern is to "cover" all the topics which might appear in the annual university examinations. The student takes detailed notes during the lectures since textbooks are not easily available and also too expensive. The student's main concern is to commit to memory all those important derivations, formulas and classical problems, which have a high probability of appearing in the annual university examinations.

A student's final grade usually depends on his performance in the big examinations held once a year, which means that he is not generally expected to work on a regular day-to-day basis on all the subjects he is taking.

Students generally do not ask questions of the lecturer and there are no lively discussions. The relationship between the student and the professor is formal both inside and outside the classroom.

As a consequence of the above characteristics of the Nigerian method of teaching and evaluation and student-teacher relationships, a Nigerian student coming to an American institution is faced with a completely different and rather strange environment. It takes him a significant length of time to get adjusted to the new system. The one requirement of the American system that seems to pose the greatest difficulty is the need to develop regular study habits and budget his time for each and every course on a daily or weekly basis and maintaining this constant pressure term after term. Another feature that presents serious difficulties is that even though a good memory is a valuable asset in an examination, it is much more important to understand, apply and even extend the material covered in the classroom.

3.2.2. Lack of Emphasis on the Practical and Design Aspects of Engineering: The engineering curriculum in Nigerian is dominated by classical subjects with the major emphasis on theoretical analysis. A Nigerian student is highly competent in mathematical manipulations and computations because of such emphasis and also because of his excellent memory training. However, he is inadequately trained in applying the material to any engineering type or design problem. Even though he can remember all the principles, equations and formulas, he is totally puzzled about how to evenget started. An example of this kind of situation occurred in a course on logic design, which was taught by the author. After a detailed discussion on ROM (Read-Only Memory) and its applications in the class, a set of three problems on the ROM was given as a "take home" exam. These problems required the use of ROM's of a given capacity and input/output relationship in applications that would usually require ROM's of larger capacity and a more extended input/output capability than the given ROM's. These problems which presented only a moderate amount of difficulty to the average American student in the same class sent the Nigerian students scurrying to the library to search through all the books on digital systems with the hope of finding an identical problem already solved.

The same kind of difficulty is experienced in the laboratory. Unless the experiments were of the routine cook-book type, the students needed an inordinate amount of help in the laboratory. The difficulties were not because the equipment was new and unfamiliar. In fact, during the author's visit to the University of Ife, he noticed that they had the same modern oscilloscopes as his own institution and the laboratory was generally well equipped.

The method of instruction is only one of the factors that lead to poor laboratory performance in the case of Nigerians. Engineers trained in the United Kingdom and other more-developed countries in an exactly similar educational system do not show the same weakness. There are causes due to the culture and environment in the country that account for the deficiencies in the engineers trained in the less developed countries. One cause is that inquisitiveness, which is an essential characteristic of a good engineer or scientist, is not particularly encouraged in such cultures. Another cause is the lack of opportunity or incentive for a young engineer-to-be to tinker with things like the automobile engine, electronics kits, etc., so as to develop a facility for designing and fixing mechanical and electrical systems. This lack of tinkering is because it is economically impractical to dismantle engines and radios or to purchase kits. Also, doing things with one's hands (getting one's hands dirty) is frowned upon in the middle and upper classes, which is where the engineering students come from.

3.2.3 Lag in Technology. It is well known that the less-developed countries lag behind more-developed countries in technology. Whereas this lag is being compensated for in the industrial and commercial sectors by importing technical expertise, the situation at the universities is still deplorable. Electronics, for example, is still being taught as it was in the sixties in the U.S. (at least ten years behind). The Nigerian engineers - even those with a degree from one of the best universities there - are far from conversant with current technology.

4. Educational Program for Nigerian Engineers

What kind of an educational program should one plan and what exactly are the steps to be taken to run the program successfully, if a group of Nigerian engineers was selected to come to the U.S. or one of the more-developed countries for continuing their engineering education?

4.1 Steps in Planning

There is a number of steps that should be taken in the planning of a program (a) Preliminary planning; (b) Period of adjustment for the group; (c) Mixing special courses and regular classes; (d) Courses for improving design and laboratory skills.

The goals of the educational program have to be identified first. Even though the program may appear to be aimed at special training only, there is a high probability that at least some of the participants will desire to obtain a degree. This possibility must be included in the initial planning and negotiating sessions, as it will affect the length of stay of the group and the cost of the project. Arrangements must be made for three to four weeks as a period of adjustment before the beginning of the formal educational program. In the initial planning of special courses, room must be made for as much laboratory work and "hands-on" experience as possible. Arrangements must also be made to have the participants attend a certain number of regular classes with the typical student population besides the special courses which are exclusively for the group. This must be done even for those participants who do not plan to work for a degree.

It is also necessary to keep in mind that the program may need some modifications as time progresses in order to permit the participants to derive the maximum benefit from their association with an American institution.

4.2 Operation of the Nigerian Project

The following discussion applies to the specific project which was directed by the author. The preliminary planning and negotiations took about eight months.

4.2.1 Period of Adjustment: The period of adjustment (which was approximately four weeks) included orientation as well as an initial classification of the students according to their level of knowledge, since the group had widely different backgrounds.

The orientation consisted of making the group familiar with the campus facilities (especially the library), degree requirements, classroom and lecture format, and general aspects of student life.

The group was informed that there will be a set of preliminary examinations to sort them out. They were given a set of problem sheets containing a large number of problems in mathematics, physics, electric circuits, electronics, linear system analysis, digital logic, and communication systems. They were asked to spend the first two weeks looking at these problems and figuring out how each one should be attacked. It was made clear that they could not possibly solve all or even a sizable portion of the problems completely, and they should therefore concentrate on the procedure. During these two weeks, tutorial sessions were held to review the various subject areas relating to the problem sets. A group of five faculty members (one from mathematics, one from physics, and three from electrical engineering) was responsible for this part of the project.

During the first two weeks, each participant was also interviewed individually for about thirty minutes. The purpose of the interview was to determine his educational and technical background, what his goals were, what he thought of the problem sets and, most importantly, what his own perceptions were about what he might accomplish during the project and after his return to Nigeria. The interviewing panel consisted of the author and two of his colleagues from electrical engineering.

The preliminary examinations were held during the third week. Four examinations were given, one per day, and each lasting three hours. These covered mathematics, physics, and electrical engineering with major emphasis on those topics covered in the first three years of an electrical engineering degree program. The students were told that they would be evaluated on how they approached each problem rather than on their ability to get correct final answers. They were also told that the evaluation would be qualitative rather than in the form of specific marks. The examinations were all open-book - a novel experience to all of them.

4.2.2 Classification of the Students: The performance of the student in the preliminary examinations was assessed by judging how good his grasp of the basic concepts were in the different subject areas. This was combined with the information gathered in the individual interviews held earlier. It became clear that the students could be divided into groups. Group I showed a level of understanding and knowledge comparable to the seniors in electrical engineering, except in electronics; Group II was comparable to between sophomores and juniors in electrical engineering; Group II was about the level of the freshman. The grouping did not correlate completely with their previous credentials, except that the three participants who had been through a regular B.S. degree in electrical engineering at a Nigerian university were all in the top group. It was found as time progressed that this initial classification was surprisingly accurate. There was only one exception - a group III student turned out to be a superior student after two terms.

Group I students were slowly phased into the M.S. degree program (one regular graduate course in the first academic term, increasing to four per term in gradual steps). Group II and III students were not permitted to take any regular credit-bearing courses during the first term, but one or two were allowed to audit a course. Eventually, depending on their performance, the students in these latter groups were phased into credit-bearing courses. After the first six months of the project, there were six students who were taking M.S. degree courses and four taking regular B.S. degree courses for credit. The others were also required to attend at least one credit-bearing regular course every quarter.

Besides the regular courses, all participants were required to take a set of special courses regularly which was the reason for the project in the first place. However, two separate sections were assigned for the special courses - one more advanced and attended by Group I and Group II students and the other attended by Group III students. The advanced sections covered the subjects at a rigorous level while the other sections kept the discussion more or less qualitative. However, there were problem assignments, laboratory sessions, quizzes, examinations and grades for the special courses just as if they were regular university courses. The faculty teaching the courses were selected with great care.

Each participant was taking a mixture of regular university courses and special courses and had a load equal to a regular full time student at the university. The pressure was quite great especially because of the need for studying each subject on a regular day to day basis and the regularity and frequency of tests and examinations.

4.2.3 Results of the Project: At the end of the project (August 1978), all the participants had taken a set of special courses covering electronics, logic design, control systems and communication systems. Six had completed the requirements of the M.S. degree in Electrical Engineering. Three others had earned a large number of credits toward the B.S. degree and would need one more year of course work to earn that degree if they returned. The special training received by the group prepared them to work in the communication system being set up in Nigeria at various level - simple maintenance to planning of future systems. Some of the men who received the M.S. degree are expected to be training or developing training programs for other engineers.

5. General Comments and Recommendations

A number of points which was learned during the project and is worth mentioning since they would affect the planning and operation of future programs.

5.1 Initial Screening

The preliminary testing and individual interviews proved to be one of the most important factors in the success of the project. Any group from a less-developed country is bound to contain a wide variety of educational qualifications and technical experience. The credentials brought by a participant do not give an accurate idea of the real level of his skills. It was found that even copies of examinations they had taken in Nigeria were not a reliable means of assessing their ability. The combination of the individual interviews, the problem sets and tutorial sessions, the preliminary examinations and the way they were evaluated proved to be the key to operating the project so that all participants were generally satisfied. There were few complaints from the bright students that they were being slowed down by their not-so-bright friends, or from the not-so bright students that the professor was over their heads.

The initial screening could be conducted in Nigeria itself by sending a team (of three professors) there in order to reduce the costs and save the really ill-prepared student from frustration.

5.2 Special Courses

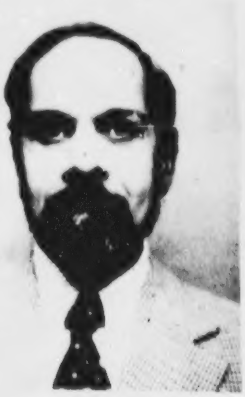
Any educational program must contain a certain number of special courses including laboratory sessions. Even when there are courses at the American institution, which cover the same material as the special courses, the offering of such courses in sections exclusively made up of the (Nigerian) group serves to ease them into the American system. When the main objective of the group is to obtain an M.S. degree (or B.S. degree by completing the junior and senior years), the first three could be devoted entirely to special courses. The topics and level of the special courses can be easily decided on the basis of the performance of the students in the preliminary examinations.

5.3 Faculty Exchange

The author is of the firm belief that only Nigerians can succeed in modifying the Nigerian educational system so as to make the Nigerian engineer more design-oriented and to make the system as up to date as possible. Therefore, it is most effective to bring Nigerian engineers to the U.S.A. (Or one of the other more-developed countries) to train and let them earn an advanced degree and if possible provide some industrial internship. They can then return to Nigeria and work at training others and bringing about needed changes in the educational system. A team of American experts going to Nigeria cannot really succeed in changing the system, since they cannot be considered by Nigerians as one of their own. "This is how we do things back home" has never been an effective method of teaching others. The best way an American team can help by going to Nigeria for any length of time is when there is already a group of well-trained engineers who need some temporary help and advice. However, an American team going to Nigeria strictly for the purpose of teaching specialized training courses for a specific group and not with visions of reforming the educational system may well be successful in accomplishing their particular goal.

6. Conclusions

The planning, negotiations and the actual running of an educational program for a group of engineers from the less-developed countries presents a challenge and an excitement. The Nigerian group proved to be dedicated, motivated, hard-working and proud. Their attitudes towards the program and the faculty were different than those of the normal American student so that it was a learning experience for the faculty as much as for the group itself.



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SUPPORT FOR CONTINUING EDUCATION IN A DEVELOPING COUNTRY

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SUMMARY

Education of engineers has got to be constantly up-dated in a dynamic society in which knowledge is expanding rapidly.

Continuing engineering education needs constant evaluation particularly in developing countries where such programmes are still largely confined to engineering educators. Short term continuing education programmes have been developed in India over the last two decades and these will be expanded. However, the participation of practicing engineers in these has been inadequate. The importance of continuing engineering education is not as yet fully appreciated by the employers, and in particular the government, which is the single largest employer of engineers in India. Financial and other support is not readily available to the engineers for continuing their education over the years. The course contents have to be matched to the great variety of needs of the participants. These and other related problems have to be solved for creating an appropriate technological ethos in predominantly agricultural societies.

INTRODUCTION

The paper describes in the following sections the process of growth of continuing engineering education in a developing country and support provided for it. The discussions and conclusion reflect the belief of the author that massive governmental support is needed for such programmes in order to surmount the manifold problems that arise. Some of these problems have been discussed.

GROWTH OF CONTINUING ENGINEERING EDUCATION IN INDIA

The oldest technical college was established in India at Guindy, Madras in 1794 and it was followed by engineering colleges at Roorkee in 1864, at Poona in 1854, and at Sibpur in 1856. These were mainly devoted to training of civil engineers needed to man the various irrigation and public works projects at that time. Training of mechanical and electrical engineers began much later at the colleges of engineering at Jadavpur and Banaras. After India attained independence in 1947, rapid expansion of technical education took place and today India has 147 engineering colleges and Institutes of technology giving courses in various branches of engineering at the first degree level and also Post-graduate courses.

After 1965 keen attention has been paid to the improvement of the base of technical education. At the same time began the emphasis on continuing education of engineers to enable them to meet the ever changing needs in the industrial sector. Simultaneously there was also a growing realization of the need for self reliance in technology and the necessity for meeting keen competition in International trade. The oil crisis brought about a shocking realization of inadequacies in many areas and focussed attention on updating every technology as well as equip the engineering personnel with more know-how and improvements in technology.

The Ministry of Education, Government of India invited the Institution of Engineers (India) early in 1964 to offer suggestions on the perspective plan of development of technical education during the period 1966-81. The recommendations of the Institution clearly laid down the guidelines for continuing education of engineers in India emphasising clearly that "as the pace of discovery quickens, it will become increasingly important for practitioners in many fields to take courses at intervals to bring them uptodate in their subjects. A wide variety of courses should be offered at all levels."

The role of engineering colleges, Institutes of technology and professional societies like the Institution of Engineers (India), as centres of activity for imparting knowledge of the latest developments and techniques in science and technology to those in employment, was also highlighted. The methods outlined included refresher courses; symposia; seminars; participation and membership of engineers in professional Institutions; deputation of Scientists abroad for on-the-job training; participation by engineers in International engineering conferences and seminars; and deputation of engineering educators, design and research engineers for work in industry for short periods ranging from three to six months.

For the success of these programmes the seminar emphasized it would be essential that; (a) financial support is available from the Central and State Governments for organising various continuing education courses; (b) financial support both from Central and State Governments and Industries is available to depute qualified engineering personnel to attend national and International conferences, seminars and projects etc.; (c) employers in the private as well as the public sector are willing to release their personnel to attend continuing education programmes; and (d) awareness is created amongst the technical personnel of the opportunities that exist to improve their knowledge and efficiency.

PRESENT STATUS OF CONTINUING ENGINEERING EDUCATION

India is a vast country with a large population. Historically and politically there are variations in the educational and developmental levels of the various constituents States of the Union of India. It is, therefore, natural to expect variations in the technological development of the different regions inspite of stupendous efforts made to bring the developmental levels at par through the mechanism of economic planning by the government and through private initiative and effort at different levels.
Variations in respect of implementation of the programmes outlined above - which are primarily meant for adoption in every part of the country- also exist. Thus one would find pockets of excellence in some regions of the country whereas in others there seem to be insurmountable difficulties in implementation of programmes. Therefore, what is described hereunder may not be taken as the average of conditions in India today but rather as a description of conditions in an underdeveloped region of a developing nation. It is believed that similar conditions would be faced by many others in the developing world and it would be well worth considering how such conditions could be rapidly improved to advance the cause of continuing engineering education at a uniform pace throughout the world and usher in an era of peace, happiness and prosperity for the peoples inhabiting our planet.

QUALITY IMPROVEMENT PROGRAMMES FOR SERVING TEACHERS

The Ministry of Education and Social Welfare, Government of India, launched the Quality Improvement Programme (QIP) in the year 1970 as a means of upgrading the expertise and capabilities of the teachers of engineering colleges and polytechnics in the country.
A significant aspect of QIP is the short duration courses, which are conducted during the summer and winter vacations every year in the various fields of engineering and technology for durations ranging from 1-4 weeks so that a large number of engineering educators are able to participate and keep themselves abreast in their respective disciplines.

These short course programmes are conducted through various agencies including the Indian Society for Technical Education (ISTE) and at selected QIP Institutions which include the five major Institutes of Technology, the Indian Institute of Science, Bangalore and the University of Roorkee.
Short courses for the training of polytechnic faculty are conducted at the Technical Teachers Training Institutes at Bhopal, Calcutta, Chandigarh and Madras. Considerable financial outlay has been made available for such programmes in the 6th Five-Year Plan (1979-84). The funds are made available by the Government of India. Any serving teacher of engineering can apply to participate in any of the programmes provided he is recommended and sponsored by his employer. The participants in the programme are paid travelling allowance for their journey from the place of work to the course venue and back and Rs. 15/- (approximately U.S. $ 1.80) per day to meet boarding and lodging expenses. Additional allowance to meet small contingent expenses on stationery and books, notes, etc., are also provided to the participants.

Depending upon the number of places available such QIP courses are also open to a limited number of engineers from industry, government departments or other similar employers. They have, however, to bear the entire cost of travel, boarding and lodging expenses, cost of books, etc. themselves or these could be borne by their sponsoring organisations/employers. They are also called upon to pay a course fee to cover the actual cost of tuition and laboratory work etc. Table-I shows the number of such courses available in India in 1978-79 (one year). The Indian Institute of Technology alone offered 36 short term courses during the period 1971-78 in which 700 teachers participated from all over the country.

TABLE-I - Number of courses available 1978-79

Type of programme	Duration	No. of courses
Summer/Winter School Programmes for college faculty under ISTE.	Min.2 weeks Max.4 weeks	40
Summer/Winter School Programmes for Polytechnic faculty under ISTE.	Min.1 week Max.3 weeks	27
Short term courses for college faculty at selected QIP Institutions Winter/Summer.	Min.1 week Max.4 weeks	65
Short term courses for Polytechnic faculty at selected QIP Institutions.	Min.3 days Max.4 weeks	217

A QIP Summer School course on 'Water Resources Engineering' with emphasis on Hydro-power development, was held in collaboration with Indian Institute of Technology, Delhi at the Regional Engineering College, Srinagar, Kashmir, in July 1978. The following data are interesting in this regard :-

a) Number of participants from engineering colleges in the country.	26
b) Number of participants from the Public Works Departments/Irrigation Departments.	Nil
c) Duration of course	2 weeks
d) Total fee received	Nil
e) Total expenditure on the course including travelling allowances, books, stationery, etc.	Rs. 40,000/- (approx. U.S. $ 5000/-).
f) Funding agencies	i) Ministry of Education, Government of India through the ISTE. ii) Marginal financial input by the host Institution.
g) Age group of participants	23 to 55 years.
h) State of origin of participants	Participants came from 15 different States of India.

Such programmes have been successfully run in the country for some good reasons. There are a large number of teachers and experts highly qualified in their respective fields who would like to share their knowledge and know-how. Equally, there are teachers who are keen to update their knowledge in a keen competitive job market. Secondly the programmes are fully subsidised and the participants have to make a minimal sacrifice from their meagre incomes. Thirdly, because the programmes are held in different parts of this vast country they provide the only means for the participant to travel to distant areas and meet engineers and see the local industries and have a feel for the actual problems. Also, progressive academic Institutions have liberally sponsored candidates for participation in such programmes. There are others however, who have equally misused the prerogative of sponsorship for administrative control of their engineering employees or for showing undue favours to some and denying the same to others. The Regional Engineering College, Srinagar, Kashmir, sponsored teachers for Summer/Winter courses as follows :-

TABLE - II

Year	1972	1973	1974	1975	1976	1977
Number of teachers who participated in short term QIP courses	3	5	4	4	1	10

Evaluation of student learning in such programmes has been attempted with varying degree of success. Not all participants are equally motivated and it is difficult to tailor the programmes to every level of knowledge and skill. Attempts are being made, however, to evaluate the impact of these programmes both in respect of the benefit which accrued to the individual teacher participant and to the Institute which had sponsored him. The sponsoring employers often insist that the participant share his acquired know-how with his colleagues as well as students in co-curricular seminars and formal courses. The participants themselves provide an evaluation of the course which serves as feedback for course improvement and modification. Ultimately through this mechanism of a "free market" quality, relevance, and early applicability of new knowledge to career development shall be evaluated constantly and courses not relevant rejected by the prospective participants.

QIP PROGRAMMES FOR TEACHERS LEADING TO HIGHER ACADEMIC DEGREES

Another continuing education programme for teachers of engineering colleges which was begun in 1970 provides special incentives to teachers for pursuing regular courses of studies at the Post-graduate level leading to their acquiring higher academic qualifications like M.Tech., and Ph.D. degrees. Teachers sponsored for such programmes are given study leave with full emoluments by their employer and are given in addition to this an allowance of upto Rs.500/- per month (approximately U.S. $ 75.00) during the tenure of the Post-graduate programme by the Institute where he pursues the course. Such research fellowships are fully funded by outright grants by the Central Govt. The number of staff members sponsored for such programmes by a college depends upon the size of the faculty as well as the qualifications of the staff at the time of initial recruitment. Such programmes were, in particular, greatly needed because of the rapid expansion of technical education in the sixties and the recruitment of engineering teachers with first degrees and some Industrial experience only.

These programmes have been found very useful by the participants and employers alike and have greatly aided in making the engineering colleges located in the various regions of the country, centres of excellence wherefrom the other members of the engineering profession engaged in government enterprises or private industry obtain their share of continuing education through various means.

The Regional Engineering College, Srinagar, which was established in 1960 made use of this facility for Post-graduate education of its faculty in a phased manner. Between 1970 and 1978, 13 teachers were sponsored for M.Tech. and 19 for Ph.D. programmes which represents about 20% of the total strength of the faculty of the college.

It would be correct to say that such programmes have been beneficial. But there have been some understandable human problems. The needs of the employing organisation have not always been in tune with those of the engineer employee. The employers insist on a legal contract with the employee which among other things stipulates that the employee shall serve the Institution for a period of 3 years after getting his education and higher degree. If he chooses to serve elsewhere then he has to pay back his full salary for the period of training and an additional penalty.

The absence of proper personnel development policies in the staff structures of technical Institutions has led to frequent movement of staff in search of higher positions and better working conditions than those available in their parent organisations. This is a type of "brain drain" from the underdeveloped Institutions to the developed ones within the country itself. Discrimination in sponsoring faculty members for higher degree programmes by the employer has also given rise to difficulties in laying down consistent personnel promotion policies.

Lack of uniformity in the application of these legal sanctions favoured those who got away into better positions without paying anything while others had to pay back all the money under law. Many technical Institutions have had to seek legal remedies in the courts against its own former staff. This is neither conducive to promoting excellence nor academic freedom.

CONTINUING EDUCATION THROUGH OTHER METHODS

Refresher Courses

The greatest advantage obtained from the programmes described above has been that the teachers in technical Institutions were highly motivated to widen the horizons of engineering knowledge of their counterparts in the practicing areas. A variety of short duration refresher courses were organised by the technical Institutions in the mid sixties and a large number of practicing engineers benefitted from these. This was also the period of rapid industrialization of the country and expansion of engineering activity. Thereby high motivation on the part of practicing engineers was ensured. Refresher courses of this type were financed by various organisations of the government primarily the Ministry of Education at the Centre. The response of the industry for financial support of such programmes has, however, been limited.

The participants from industry or the engineering organisations of the government have to pay a regular fee for such courses and often the technical Institutions may choose to finance the programme entirely from the fees thus received. The employer does not usually subscribe to the employees needs, and some time even leave may be rejected on one pretext or the other which prevents the employee from participating in continuing engineering education course relevant to his work and field. Such an attitude springs from the ignorance of the employers in developing countries who do not fully appreciate the benefits of such education to their own organisational needs.

Those at the top - who are to take vital decisions in this matter of policy and divide the national cake - are most of the time only remotely aware of the role of technology in a fast developing nation and needed improvements dawn on them slowly through the slow processes of the "free market" in the language of economic losses which alone they readily understand. It is, only at a rather painful pace, that the voice of concern of the motivated technologists is heeded and some dent made in improving matters. Most of the time, however, whatever else the technologists might impress upon the decision makers remain mostly what the author likes to call "shouts in the wilderness".

In a developing country with a predominent sector of engineering and technology under the government, it is the paramount need of the hour that the governments sponsor and support in a massive way, continuing engineering education programmes for their engineering employees and thereby generate all round improvement in technical education and technology applications.

Short term courses for executives

There is another type of continuing education programme for technologists and managers employed in industry and government which has remained financially viable. These are programmes for the top brass run by the National Productivity Council. The participants pay a high fee varying from U.S. $ 200 to 400 and the course is conducted for about two weeks in various cities around the country. Services of experts from industry and academies are obtained to conduct these courses which are variously described as seminars, symposia, or workshops. The participants do receive full financial assistance from their employers for such programmes. The author ascribes their continued success to the fact that the courses are exclusive and as an inference these should be useful; the participants from the government side belong to the elite Indian Administrative Service and it is easy for them to sanction fees in their own favour; private sector industry finances participation of its own executives from a purely business angle, it is good for their executives to know and meet top brass from government which pays dividends in the long run. And above all such programmes provide greatly needed "excursions" away from routine and drudgery to a more salubrious environment.

Role of professional societies

The Institution of Engineers (India) has been in existence for more than half a century. After 1947, it has made significant contribution in many areas of professional activity including continuing education of engineers in the country. The author wishes to highlight the Institution's role in Jammu & Kashmir State which is a relatively underdeveloped, predominantly agricultural region of India which is not as yet on the railwaymap of the country, but has prematurely entered the television era. Such "telescopic revolutions" create a strange societal mix and similar problems. Many of the elite could be aptly describe as people with their heads in the Piccadily Circus and bodies upto their neck in a quagmire.

The first few engineers of the State were trained at Harvard U.S.A. in the early thirties. Simultaneously came up the first technical school to train technicians. The first Polytechnic and engineering school were established in 1960 followed by the establishment of the Local Chapter of the Institution of Engineers (India) in 1961. By 1965 the local Chapter had only 65 members on its rolls although the number of eligible members was four times this number. Around this time a big start was, however, made to organize paper meetings and seminars for the benefit of members as well as others in the profession.

Twenty four seminars were organised by the Local Chapter during the period October 1966 to September 1978. The number of participants at these seminars gradually rose from about thirty in 1966 to 125 in 1978.

Engineers in government employ who attend these programmes are given leave of absence. Financial support is not needed because participation is subject to a payment of nominal registration fee, the main expenses being borne by the Institution itself. The membership of the Institution rose from 65 to 275 in the same period as a result of the growing awareness by engineers of the need for keeping abreast in their respective fields of activity which role the professional society performed well.

The Institution of Engineers has also begun in 1977 the Engineering Staff College which offers professional engineers a range "of practical, creative, in-depth learning, problem-solving programmes designed to equip them with best technological tools". The three phase course will begin with a 50 hour instruction module of 4 weeks duration and conducted by specified local chapters; Phase II is a 12 week programme at the Engineering Staff College; followed by Phase III which is project work based on the participants own area of activity. The author organised three Phase I evening courses on Inventory Control; Advances in highway design ; and Dynamics of Machine Structures in 1978. The number of participants varied from 11 to 18 and their average age was around 30 years. Course fee was approximately U.S. $ 7.00 which they paid themselves. The group was highly motivated to learn more in their respective fields.
Most participants were engineers employed in industry or construction.
Support for courses sponsored by the Institution of Engineers (India) is not forthcoming from the employers.

COURSE CONTENTS FOR CONTINUING EDUCATION

Lack of support for continuing education by employers could be partly attributed to the fact that course content of continuing education programmes run by the educational Institutions are too sophisticated and advanced as compared with the actual needs of engineers' work. So it happens that the employer's Chief Engineer may not recommend such a programme for his younger colleagues because he considers these irrelevant.

Engineering educators who prepare and conduct such courses may never have had any industrial experience and they would like to emphasize the more sophisticated developments in the advancing technologies without concrete application to practice.
The participating engineer would, however, be keen to get more practical know-how which is immediately relevant to the professional tasks confronting him.
The course content needed also varies with the age group of the engineer. Many engineers move into managerial positions by the age of 45 or so which requires a number of managerial skills. Thus most of the continuing education for them should be in disciplines other than engineering. Courses on decision making, managerial and communication skills are high on the wanted list of engineers. The age group of engineers between 25-40 who did not attend full-time Post-graduate programmes would welcome job oriented courses making them more familiar in the use of computers in their routine duties.

One of the difficulties faced in respect of devising such courses arises from the fact that practicing engineers in large numbers are engrossed in developmental tasks which need quick decisions in a hurry. There is hardly any time for reflection, even less for sharing of experience with others in the profession. Thus it is seen that the various journals of the Institution of Engineers (India) contain published papers by engineering educators on topics which are highly academic in character and only very remotely connected with immediate professional tasks.
The practicing engineers complain that all these mean nothing to them.
So there is a wide gulf in basic approach and objectives which must be bridged.
A close collaboration between the two aspects of the profession in devising continuing education programmes for

engineers in various age groups is necessary.

CONCLUDING REMARKS

In conclusion this paper has presented a few observations which are relevant to continuing education in developing countries and made some suggestions which if implemented would make these programmes more meaningful.

Success for professional growth largely depends on action from the top. Motivation has to be induced through "Planning by direction".
Decision makers have to be visionaries who can appreciate the role of science and technology in improving life. Growth of continuing education in developing countries is directly proportional to governmental action and attitudes. The private Industrial sector in these countries is small and their role is not significant.

The growth of technological ethos in a feudal-agricultural society is painfully slow, so much so that even a large number of well trained engineers and technologists may loose sight of their own role in a milieu where other values dominate. Contentment is the keyword in a conformist status-quo society and continuing education concept is a misfit in such a situation.

Although continuing education requires a commitment on the part of the individual it is the duty of the engineering profession and the government (as a major employer) to assume greater responsibility and encourage, actively support, and help plan continuing education activities of their employers. In Industrially advanced countries there is a marked trend towards virtually full financial support by enlightened employers.
In developing countries such support is most urgently needed.

The professional societies must take part in planning and developing continuing education programmes, and conducting these in active collaboration with the educational institutions and the local chapters of the society located in the vicinity. Low salaried engineers must be encouraged to seek professional society membership by subsidizing their entrance and membership fees.

Course contents must be thoughtfully designed to cater the needs of practicing engineers in different age group, related to work and based on the desires and needs of the profession.

All activities related to continuing education could be co-ordinated by a single organisation bringing engineers, employers, educational institutions and professional societies together for the purpose. For example, the Indian Society for Technical Education could monitor all such programmes and make these adequate to meet the needs of the entire engineering profession. Programmes like the Quality Improvement Programme for teachers should be extended to cover the entire profession and similarly supported.

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In 1960-1963, Dr. Wakhlu was a Commonwealth Scholar in the United Kingdom. Later in 1968-1969 he was Alexander Von Humboldt Visiting Research Professor at the Karlsruhe University in West Germany.

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THE IMPORTANCE OF CONTINUING EDUCATION FOR INSPECTORS

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CERTIFICATION PROGRAMS IN BUSINESS AND TECHNICAL DISCIPLINES

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United States of America

SANITARY ENGINEERING FOR WORLD HEALTH (TDS)

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Peru

A NATIONAL PROGRAM FOR OIL AND PETROCHEMICAL INDUSTRIES IN VENEZUELA

Vladimir Yackovlev
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INETET
Venezuela

Effrain Barberii
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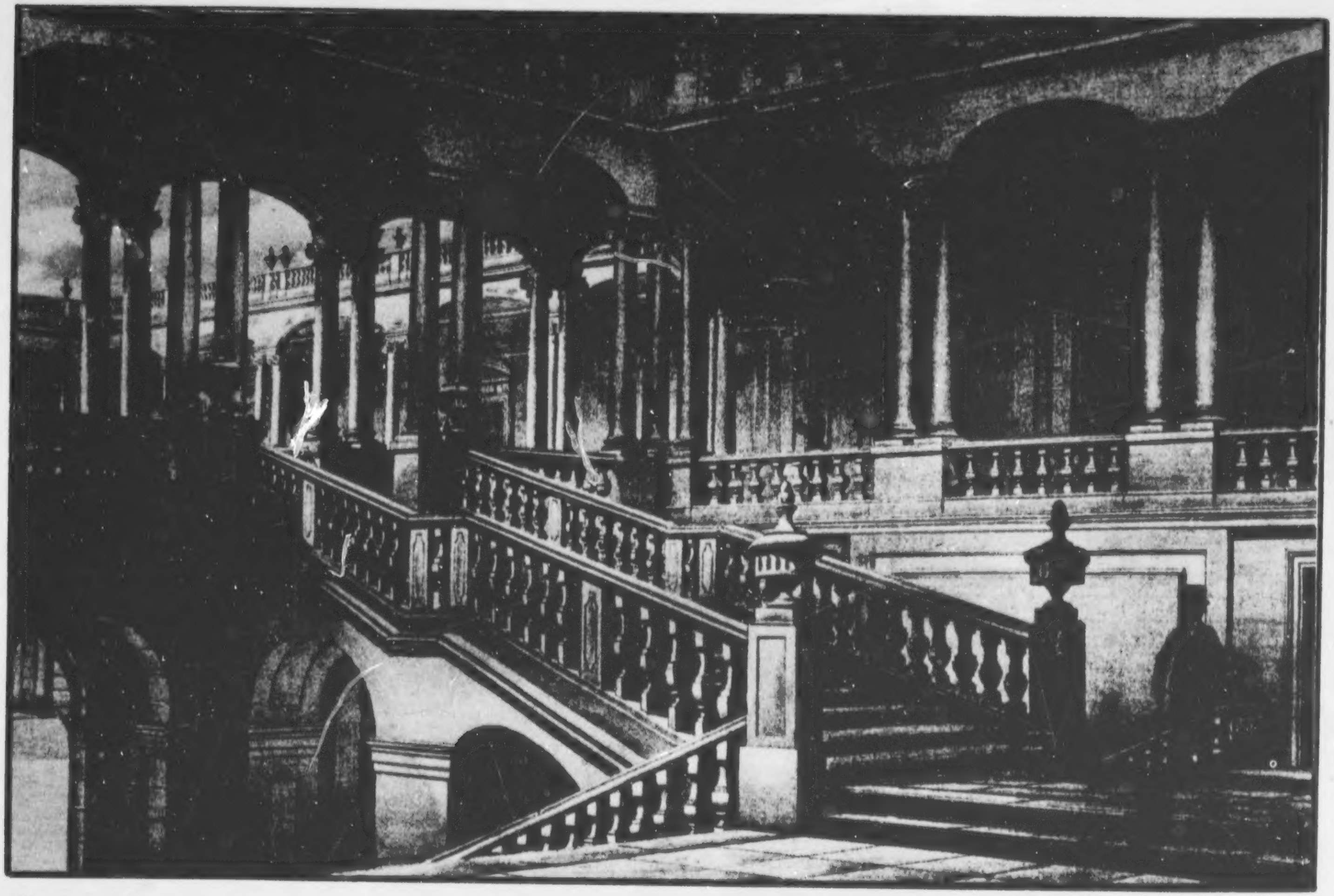
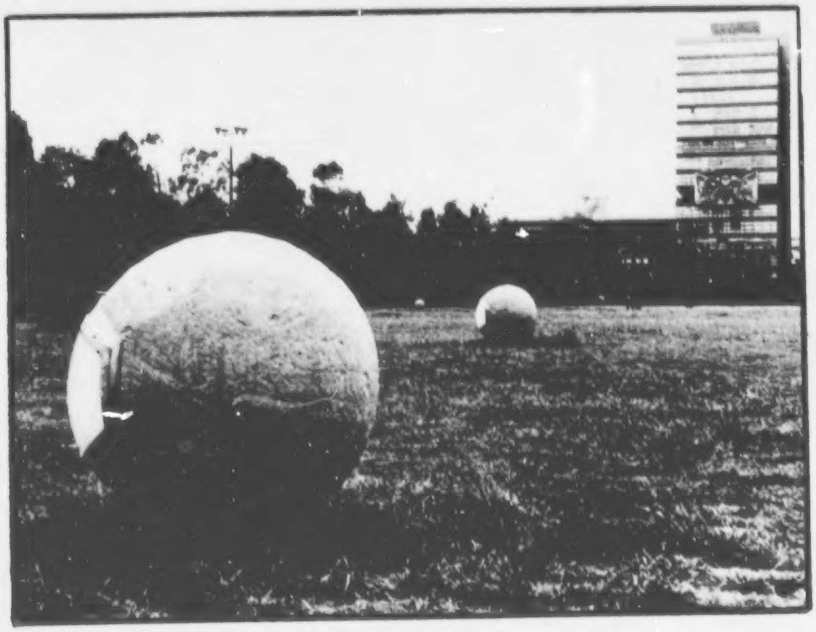
SCENES FROM MEXICO



The Grand Stairway

SCENES FROM MEXICO



SESSION 6B

GROUP II

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ENGINEERS/MANAGERS IN EUROPE

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ENGINEERS/MANAGERS IN EUROPE

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Part 1 gives some information by way of introduction or background for the presentation - during the conference - of some innovative European approaches to help engineers to 'manage' more successfully. These are described in Part 2. The examples given are from Britain; approaches from other countries will be discussed during the conference. The Paper ends with some questions being asked in Europe : attempts will be made to answer them during the presentation at the conference.

Engineers - who are they?

Each country gives a different meaning to "engineer". In Germany the Dipl Ing (professional engineer) and the Ing Grad (technician engineer) are protected by law and only persons holding these qualifications are classified as engineers. A similar state of affairs exists in some other European countries.

In Britain there are at least 3 kinds of engineers, technician, professional, chartered, and the title engineer has a wide connotation, ranging from the shop floor to the engineers who design Concorde.

In France, the title Ingénieur is not controlled either; only the title Ingénieur Diplômé (diploma engineer) is protected by law. Teaching establishments can only award the title Diplômé d'Ingénieur if they have been authorised to do so by the Minister. French diploma engineers must normally specify the School from which they have graduated, by using the appropriate abbreviations, which are themselves controlled.

Post Secondary Engineering - Education and Training

In France and Germany the pre-eminent institutions in engineering education fall outside the traditional university system. The Technische Hochschulen are the most prestigious institutions in Germany. There are twelve of them with student populations in the 6,000 - 12,000 range, and their standards are comparable with each other. The French Grandes Ecoles are comparatively small; only 20 out of a total of 145 have an annual intake of 300 or more. They fall into two groups; those that give a general education, such as Ecole Polytechnique and those related to a particular branch of engineering, such as mechanical engineering. A student may proceed from the former to the latter. In Britain the traditional universities play an important part in engineering education.

Entry

To qualify for entry to these institutions, students have to pass examinations. In Germany, in the past some 90% of all those qualified (by Abitur or similar certificate) went on to a higher education and of these a high proportion to study engineering; this year, only some 70% wish to continue their studies and the number applying for engineering studies is well below the places available.

The German engineering student is required to complete a basic training programme in 13 to 26 weeks in industry prior to starting his studies. Although Britain requires a fairly high degree of specialisation in science subjects,engineering students tend to have lower academic qualifications than those studying other subjects such as medicine, languages, architecture, social sciences, art or even science.

In France, entry to the 147 specially designated engineering schools entitled to award the Diplôme is highly selective and very often takes the place of a competitive examination after 2 years in classes préparatoires.

Training

The development of professional level engineers takes a minimum of five years' education and training. In Germany, the average length of the course in practice averages 5.8 years. In France, post-Baccalaureat studies for the d'Ingénieur Diplômé take five to six years. All over Europe the first half of the academic training is non-specific and designed to give the student a broad base in engineering science from which he can launch himself into the second half, which aims to provide structured training in the application of the scientific method and outlook to the analysis and solution of engineering problems. It is in the second part where the British system stands apart from the rest. Most European countries assign the full responsibility for both parts to the academic establishment. Britain divides responsibility three ways - the first part to the universities, the second part to industry, and the third part, the monitoring role, to the professional institutions.

Employment

Employment patterns of engineers vary considerably and the British picture in 1977 looked thus:

% of Technician Engineers	% of Chartered Engineers	Employed by
41.9	43.7	Industrial or Commercial company
2.5	8.8	Firms of consultants
15.4	13.1	Nationalised industry
3.7	3.1	Public corporation
15.4	12.0	Local authority
5.1	3.0	Regional authority
5.4	5.7	Central government
3.7	2.3	Armed forces
0.7	2.4	University
3.0	2.9	Self employed
3.2	2.8	Other employers

and for British Technian Engineers belonging to the Institution Electrical and Electronics Engineers like this:

Electricity generation or distribution	25.6%
Building Services	16.0%
Research and education	9.3%
Communications services and transportation	8.7%
Electronic or telecommunications equipment development or manufacture	10.8%
General administration and other work	5.9%
Electrical machinery equipment development or manufacture	8.1%
Other development, manufacturing or processing	5.8%
Other engineering services	5.6%
Armed forces	4.2%

Up to date information on other countries will be presented at the conference.

Misutilization and under-utilization of engineers

Research reveals that engineers (as well as other highly qualified) are often greatly mis- and under- utilized, either by not being employed in an engineering job or by inadequacies in job design. One study by Hutton and Gerstl in 1962 showed that half the engineers they surveyed considered that parts of their work could be done by someone with less technical training. Another British study showed that 23% of engineers were "employed in occupations where it is unlikely that they were making direct use of their qualifications".[1] Yet another study that "even where the engineer is employed in an engineering function, he may only do engineering work a few hours a day: the level and type of work may make little use of his general and specific skills; or he may work with other factors that are inefficient such as faulty equipment or untrained technicians"[2]. A study of mechanical engineers found that 52% of those included complained that their skills were not fully utilized.[3]

A recent extensive national survey in the Republic of Ireland concluded that: the sub-optimal use of scientific and engineering manpower results in strong feelings of job dis-satisfaction; serious inadequacies in the education and training of scientist and engineers aggrevate the misuse of talent and job dis-satisfaction; non-professional work done by engineers and scientists deprives many less qualified young people of job opportunities.

It may be worthwhile to bear these points in mind when considering the basic and further education and training of engineers.

Further Training of Chartered Engineers categorised by age/below 40

Further Training	30 Full Time %	30 Part Time %	30to39 Full Time %	30to39 Part Time %
Technical updating in respondent's technology	13.3	5.8	10.8	5.2
Retraining in a different technology	2.7	1.5	2.4	1.6
Business studies, or management training	11.6	6.9	14.6	6.2
Foreign languages	0.5	3.9	0.7	4.2
Expenses met by Self	3.8	37.9	4.3	36.1
Employer	92.9	61.6	93.9	62.8
Other outside source	3.3	0.5	1.8	1.1

The review was taken in the period second quarter 1976 to second quarter 1977.

Full-time courses were defined as lasting one week or more. Part-time courses were included if they totalled 40 hours or more (roughly equivalent to a full-week).

Those over 40 years of age; some 14% had full-time, and 10% part-time technical updating. Some 9% retraining in a different technology, 30% further training in Business studies and 10% in Foreign languages.

Up to date information for other European countries will be presented at the conference.

Further Training of Technician Engineers categorised by age/below 40

	30		30to39	
Further Training	Full Time %	Part Time %	Full Time %	Part Time %
Technical updating in respondent's technology	18.5	15.9	15.3	11.3
Retraining in a different technology	2.6	5.2	3.2	3.9
Business Studies, or management training	14.2	8.2	13.8	6.4
Foreign languages	1.3	1.7	0.9	3.8
Expenses met by Self	-	-	5.6	37.4
Employer	-	-	94.0	62.0
Other outside source	-	-	0.4	0.6

Of Technician Engineers over 40 years of age, nearly 50% had updating in their technology, 12% retraining, more than 40% attended Business Studies but less than 10% studied foreign languages.

The amount of further training undertaken by Chartered Engineers has decreased since the 1975 Survey.

A greater proportion of Technician Engineers than Chartered Engineers undertake training, particularly is this so in updating in the respondent's own technology.

It must be noted that the Employer pays for over 90% of full-time courses but for just under 60% of the part-time courses, for all age groups.

It is also to be noted that whilst over 40% of all engineers were dissatisfied with training in foreign languages very few appear to be rectifying this deficiency.

Up to date information for other European countries will be presented at the conference.

Study Leave

Many organisations in Europe make it possible for their employees, including engineers, to study away from work - sometimes for as long as a year - to update themselves professionally for higher academic qualifications, on general management programmes.

There are company or industry 'staff colleges' the latter often working in collaboration with the Government - especially in Eastern Europe or in the case of nationalised industries - universities and other institutions of higher learning and some independent post-experience centres, such as for instance the Administrative Staff College in England and CEDEP (Centre Europeen d'Education Permanente) in France. Its programme is a sandwich spread over two-and-a-half years and divided into eight residential periods, each of approximately two weeks duration with three months intervals between periods (except for a six month interval between the fifth and sixth).

Paid educational leave is today an individual right in France, Belgium, Italy, Yugoslavia and Sweden and is about to be adopted in the Netherlands. Two rights are involved; that of taking leave and that of choosing, within certain limits, the course of studies. Leave is not always paid and the arrangements vary from country to country. What experience there is suggests that it is mainly the better qualified, highly motivated who apply for paid study leave and that employers tend to grant leave for the shorter, more highly vocational and to them directly useful kind of programmes; long periods for general education or longer-term career development are rarely allowed.

Part 2

The Engineer/Manager

Engineers, if successful in their work, inevitably tend to be promoted into positions where they have to manage, often other engineers. In Britain, in 1977 more than 30% of Chartered Engineers were in General Management and Technical Administration and 26.9% of Technician Engineers. An analysis of the membership of the Institution of Electrical and Electronics Engineers show that nearly 20% are in Management and Consultancy.

In other European countries where Engineering has been more highly valued, the number of qualified engineers in managerial position is higher than in Britain. (Detailed information on various countries will be presented at the Conference).

It is likely that more qualified engineers will become managers as opportunities for engineering work diminish and the demand for supervisors and managers grows. What knowledge, skills and attitudes does the engineer require to be a competent manager, how far does his basic training equip him for the managerial task, what new learning needs may he have and when and how should they be met?

Some experts suggest that Engineering is primarily "things-oriented" while management is mainly "people-oriented", that engineering is concerned with the application of general principles to detailed problems, whilst the manager has to take a wide-angle view on situations and circumstances and has to plan, organise, communicate and motivate, educate and train, and to control.

Conventional training of engineers should help them with the first two - at least - but is likely to be deficient in preparing them to deal with people, be able to communicate with and to motivate, coach and counsel subordinates, ...

When British engineers were asked to indicate subjects in which they considered their education and training had been inadequate over 40% of chartered and technician engineers mentioned languages, nearly 40% of C.E. and 30% of technicians basic accountancy, a third management and law.

According to a recent report[4] the future European manager will need real understanding of the emerging forces in society and will have to make the major effort, learning languages, seeking to understand other cultures and keeping himself constantly abreast of changes in the political, economic and social environment. In addition throughout his working life there should be developed, in discussion and by agreement with him, a phased programme of training and development opportunities extending from recruitment well into his 50's, in the form of "education permanente".

To prepare tomorrow's engineer/manager may require changes in educational and training approaches. To convert today's engineer into tomorrow's manager, it may be necessary to pass him through several conversion processes. What are the approaches being looked at in Europe?

Some European Approaches

Here are a few from Britain: those in other European countries will be discussed during the conference.

One approach is more management education and training during the undergraduate course, partly to provide a better basis for management training later on.

Cambridge - one of Britain's oldest and most prestigious Universities - is introducing a new four-year undergraduate course in Production Engineering and Management. Students taking the new course will follow the existing engineering course for the first two years and will then spend their third and fourth years studying the fundamentals of engineering production and management.

The main subjects to be studied (i) Production Technology (ii) Engineering Design and Manufacturing Processes (iii) Organisation and Control of Production Systems (iv) Human Behaviour, Personnel Management and Industrial Relations and (v) Financial Aspects of Management.

The third-year course will be of the conventional University form but in the fourth year a student's time will be divided between lecture courses, industrially based projects, case studies and industrial visits, all related to the engineering production and management fields.

A number of Universities and Polytechnics have developed short courses of a few weeks duration to update practising engineers and to enable them to obtain higher qualifications by taking numerous "modules" and collecting credits in both technological and managerial subjects.

Further Education and Study Leave

There is every reason to think that a growing number of adults will ask for and will be allowed and/or encouraged to take further training as the working week shortens, leisure increases and continuing education becomes more widely accepted.

A British Report[5] recommends that every qualified engineer should be entitled, as of right, after fifteen years of industrial experience, to take a university course of up to one year's duration in order to update, broaden and add to his capabilities.

Most countries in Europe, have a "University of the Air" a degree awarding University using Radio, Television, printed material and 'summer-schools'. Britain's Open University attracted. in 1978, some 42,000 applications of which 50% were admitted. 60% of the students read Arts and Social Sciences, 15% Mathematics, 16% Science and 10% Technology. Students have to take six credit courses to gain a degree. Some 90% take only one credit course a year.

Self-Development

Today there is a general trend to "self-development" approaches, caused by:
a) varying degrees of dissatisfaction with many forms of institutionalised, expert based development activities
b) the promise that, in resource terms, it is a more economical way of achieving development, partly because such learning is likely to be continuous and self-sustaining
c) its adaptability to the contingencies of different individuals in different organisations, with different roles, past experiences and possible futures
d) its connection with trends towards personal responsibility, individual autonomy, democratisation, participation, ...

Certification

The growing scarcity of jobs and the threat of Certification may motivate much additional self-development.

A growing number of professions require additional training every few years to maintain "certification" - the right to practise. It has been suggested that Engineering degrees should be licenced, subject to renewal about every ten years, and the renewal operation should consist of three months away from work at a university or similar institution. Although "certification" is unlikely to be required for managers during this century, voluntary moves by teaching and professional institutions in this direction may well increase, and individuals may seek certificates of all kinds, partly for their own self-respect and more specifically as a way of favourably differentiating between the services they offer.

Action Learning

Pioneered by Prof. Reg Bevans in Belgium and now, often with modifications, is used in many parts of the world (Spain, Egypt, India) and within some large companies, for instance General Electric in Britain. Action Learning is a method of management development which involves putting a manager against a hitherto unresolved organisational problem. He or she has a client to satisfy who owns the problem and who will help with matters of access to information and to those in the organisation who can influence the situation. For support, the manager joins a set of a few other managers facing similar problems. Each set has a professional adviser whose role is to develop the "set" into a learning community: in A. L. managers learn primarily with and from each other, not from professional educators.

Another approach, growing in importance, are Joint Development Activities, a form of work-problem based learning activity, in which an educational institution, e.g. Manchester Business or Bath University's School of Engineering, works with a client organisation. The main contrast between A.L. and J. D. A. is that here participants work singly or as a team on an own-organisation problem rather than on other-company or other-unit problems.

Yet another approach is the Teaching Company. This is a separate entity, jointly established between and managed by an Engineering company, a University or Polytechnic (and the Government) to develop carefully selected technologists to improve their competence by working on projects for about 2 years, at the end of which they may obtain a higher academic qualification.

Some questions asked in Britain

(Similar questions being asked in other European countries will be looked at during the conference)

What is the "right" amount of management education training in a four or five year undergraduate programme for engineers?

Should such education/training be given to all engineering students, to the most able only, the more "practical", the less able, those who ask for it .....? Should it be given throughout the entire programme, in the last two years only, ...? Whatever is or is not done at undergraduate level, how can management training be more readily available during the in-service/on-the-job/post-experience stage, as part of continuous education:

as an employee's right

only when the recipient of such training can apply it on the job

because the employer and/or employee considers it desirable/helpful?

for at least 2½% of an employee's time (a week per year) each year?

for a month after every five years

for two or three months every ten years

paid for by the employee, employer, State .....?

Who should provide learning opportunities/provisions:

Universities, polytechnics, professional **institutions**, employing organisation, unions, independent bodies, ...?

How much career advice should be made available to the employee?
by whom: employer, union professional body, State?

Who should ensure that the provisions are properly used:
employee, employer, union, professional body, State?

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AN UNDERGRADUATE PROGRAM DESIGNED FOR LIFELONG LEARNING

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Introduction

The intent of this paper is to describe a unique educational program known as the "WPI Plan" which resulted from a deep and comprehensive examination of the fundamentals of the learning process. The Plan is a new binary concept of education which joins theory and practice in a dynamic, interactive fashion. The result is an innovative yet sound approach to science and engineering education which is directly relevant to the purpose and process of lifelong learning.

The educational concept is worthy of serious consideration by countries or institutions which desire to couple their educational programs with plans for economic and social development. Also, the concept is relevant to the so-called developed countries in situations where they seek to provide a real alternative to traditional programs of technological education.

The Setting - Worcester Polytechnic Institute

Worcester Polytechnic Institute (WPI) was founded in 1865 in Worcester, Massachusetts with the goal of providing a technical education to artisans who perceived the need for knowledge to give understanding to their labor. The institution grew and played a leading role in providing talented engineers and applied scientists to the Massachusetts - New England region, which was the original heartland of the industrial revolution in the United States. Thus, WPI played a vital role in the early economic development of the region. That role is still being fulfilled in its modern context today because a major segment of the computer industry is located nearby in Massachusetts.

WPI now has an undergraduate student body of 2400 students distributed in the usual range of major engineering disciplines, together with degree programs in physics, chemistry, and mathematics. These programs all lead to the B.Sc. degree. There are about 600 graduate students enrolled in master's and doctoral level programs, the majority of whom are part-time by virtue of employment in neighboring industries. The Institute has also developed a vigorous program of Continuing Education which offers a wide array of engineering and management courses to regional engineers and professional employees. It possesses an excellent library, extensive computing facilities, and an instructional television system (ITV) which links the entire campus in a communications network. The full-time, regular faculty number 170. WPI is a privately endowed, privately operated college. The Institute possesses the Alden Research Laboratory, a world renowned facility for research in hydraulics and fluid mechanics.

The Concept - Binary Education

The founding educational concept of the institution was summarized in its emblem as "Lehr und Kunst," or theory and practice. It was recognized that it is the intimate union of knowledge and its application which keeps education vital. This dual nature of education implies another important aspect of learning - the willingness to experiment. Experiment is absolutely essential in helping us avoid the latent self-deception of knowledge untested by application and in arousing our curiosity to understand the reason behind observed practice. "Lehr und Kunst" is an expression of the binary nature of education - a property which is essential if it is to remain authentic and vigorous.

In the late 1800's the union of theory and practice at WPI led to what was then a completely unique educational program - a combination of scientific and technical studies with practical work in model industrial shops. It formed the educational base for many engineering schools in the United States. As the industrial revolution evolved, engineering education changed and the original WPI concept gradually lost its uniqueness. However, the force of its binary concept remained as a latent educational imperative.

We now recognize that the post-World War II era has been one of major change for engineering education. The two dominant developments have been (1) the introduction of a greatly enhanced level of theoretical content and (2) the creation of relatively large graduate programs based on research. Thus, in recent times engineering education has witnessed a trend in which theory has become dominant. In fact, some educators believe that the desired balance has been lost and an intellectual aristocracy has been established in which knowledge has been elevated far above experience and experiment. These two major developments were simply superposed on the traditional structure and practice of engineering education.

It is out of this background that in 1968 WPI embarked on a complete and systematic revision of its traditional approach to undergraduate engineering education. The initiative for charge came from faculty dissatisfaction with the way traditional curricular rigidity sapped student motivation and initiative. There was a growing concern that engineering and science students were so constrained by the requirements of an impersonal, lockstep system that their full development as individuals was not being achieved. There was the further concern that the traditional system encouraged a passive mode of education which was inconsistent with the lifelong learning needs of a modern professional.

The gap between the existing state and the desired learning environment was summarized in the following manner[1].

> "No one ever questioned the need for a firm foundation in science and engineering fundamentals; but beyond that a number of paradoxical situations appeared. A rigid academic program offered little opportunity for the student to assume responsibility for defining personal objectives, yet immediately after graduation the individual had to assume total responsibility. Courses developed long, narrow corridors of knowledge, while professional practice required integration of knowledge. The classroom experience was basically passive, although professional practice required self-activation. In the academic setting, the student was usually an isolated learner, but engineering practice involved personal interactions, shared experiences, and effective communication."

It was out of a desire to reconcile these contradictions that, after two years of intensive planning, the WPI faculty in 1970 introduced its new philosophy of learning, now widely known as the "WPI Plan."

This Plan utilizes knowledge-based courses, but it places a heavy emphasis on experiential learning through the use of projects.[2] Students must assume significant responsibility for planning their programs, they must demonstrate that they can learn on their own, and that they can translate their learning into worthwhile action. Thus, Worcester Polytechnic Institute introduced an educational reform which gave a new and vigorous interpretation to the concept of binary education. The strength of the WPI Plan lies in its assertion in new form of the basic unity of knowledge and practice.

A Unique Educational Program - The WPI Plan

In order to translate the above objectives into a comprehensive, flexible educational program, four bachelor of science degree requirements were specified in the following manner:

1. A qualifying project dealing with a problem in one's major field (MQP) - ¼ year equivalent;
2. A qualifying project relating science and technology to societal concern and human need (IQP) - ¼ year equivalent;
3. A sufficiency minor in an area of the humanities which requires a degree of concentration on the area - ½ year equivalent;
4. A competency examination in the major field of study - 1 week duration.

Clearly, these degree requirements represent a significant departure from traditional graduation requirements, which usually take the form of passing a predetermined sequence of courses. Although the passing of courses is no longer sufficient for graduation, courses still provide the major formal means of transmitting information. In addition, there is an unmistakable emphasis on experiential learning through the medium of projects and performance as measures of success.

The full impact and meaning of the above degree requirements can only be understood through a description of their implementation.

1. Major Qualifying Project (MQP)

   This project must deal with the student's major area of interest and it is intended to translate theoretical understanding to practical application. Projects are selected by the student and a high degree of individual initiative and self-motivation are required in project definition, development and completion. The students work under the guidance of a faculty member. Although many significant projects have been done alone, usually the work is done in teams of 2 or 3 students so that the opportunity is provided for learning and leadership in a group setting.

   A most important feature of the project approach is the incorporation of real life, off-campus situations. A great effort has gone into the creation of projects which are carried out at neighboring industrial company locations. About 250 students per year participate in such projects and a very close and constructive liaison exists between faculty members and industrial practitioners. When a group of projects at a given company reaches a critical size, a corporate Project Center is identified in order to facilitate the relationship.

   As indicated above, a significant block of time is devoted to the MQP. Each project includes a carefully planned, documented, and written student proposal (including costs) before work is initiated. Oral and written progress reports at specified times are required. A final report that is well written, carefully documented, and acceptable to both campus and off-campus advisors is the culmination point for the MQP.

2. Interactive Qualifying Project (IQP)

The purpose of this project is to relate science and technology to societal concerns and human need. Hence, the word "interactive" is used to describe the intent. While traditional engineering curricula require a nominal number of courses in the social sciences and humanities, the integrative, interactive experience is usually missing. Thus, the IQP is a direct attempt to rectify this deficiency. As with the MQP, students are required to select and define their projects. Small group work is encouraged. Although both technically-based faculty and social science or humanities faculty are encouraged to lead interactive projects, clearly, this requirement provides the opportunity for the social science and humanities faculty to participate directly in an important aspect of the educational objective.

Again, the use of off-campus project sites is encouraged and WPI has created a network of such contacts. Here, however, the coupling is with public or civic organizations and it focuses on some aspect of the interface between technology and society or technology and human values. Because of the richness of opportunities at concentrated public agency sites, WPI has established a Project Center in Washington, D. C. Students and faculty advisors based in Washington do their projects in affiliation with such Federal agencies as the Department of Transportation, Housing and Urban Development, Health, Education and Welfare, and the National Science Foundation. Closer to home, project teams are doing interactive projects with private and public agencies at the state and local levels. In order to provide a coordinating mechanism, the interactive program is operated through a Division of Interdisciplinary Affairs on the WPI campus.

The IQP also requires a significant block of time and the planning, progress evaluation, documentation, and reporting procedures are equivalent to those of the MQP.

The Interactive Qualifying Project recognizes in explicit terms the importance of understanding and constructively integrating the technical and societal aspects of modern society. It also recognizes that, although engineers and scientists must be well grounded in their technical specialties, it is very often non-technical factors which constrain, dominate, or control the final decision making process. Clearly, this dimension is of great significance in both the formative, subsequent lifelong career development, and leadership stages of engineering professionals.

3. Humanities Sufficiency

The structure of this requirement[1] is based on the assumption that it is better to develop deeper understanding in at least one area of the humanities than to have an introductory view of many. To this end, the student selects five thematically related courses, and in a sixth course conducts an independent study based upon a unifying theme of the selected courses. Alternatively, the student may prefer to develop the equivalent of the course material entirely on his or her own, through independent study. Sufficiencies have been done in history, philosophy, languages, literature, music, and drama. In some cases the sufficiency involves the role or influence of science or technology in the humanistic field.

The purpose of the focused, in-depth study of a humanities area of the student's choice is to help them acquire the information, skills, and frame of reference so that in their final independent work they can escape the relative passivity of course work and begin to exercise their own creativity and insight. The Sufficiency is intended to give a "sufficient" background and overview to enable students to comprehend how the mind functions while appreciating, criticizing, and creating in the humanities. The process of course study, in which each student selects an individual sequence of courses, and the final original essay are intended to foster for engineering and science students a commitment to lifelong learning in the humanities.

4. Competency Examination

Competence in the student's major field is, of course, the sine qua non for any student of engineering and science. Course and project work is intended to provide the necessary foundation in theory and practice, but a final competency examination emphasizes the educational importance of a comprehensive understanding.

The competency examination is an extended test in which the student is assigned a complex problem similar to one arising in a job situation. The student has access to reference materials, computer facilities, library, laboratory, and faculty assistance as would be the case in a real life position. At the end of an assigned period a written report summarizing the analysis and conclusions is made to a faculty examination committee. An oral examination follows in which the student defends his method of approach, difficulties encountered, limitations, of fundamental principles, alternatives, and final recommendations. The competency examination is designed to test for an understanding of relevant methods (both analytical and experimental), resources available, fundamental principles, as well as current techniques which can be brought to bear in solving a technological problem. The process is not only a comprehensive, integrating experience but it also provides a bridging experience for the individual from the student role to that of a beginning professional.

The four degree requirements described above contain substance of WPI's binary concept of education. As can be seen, they represent a major reform of engineering education. What cannot be described here in any adequate detail is the impact which such a program has on an academic institution. Tremendous enthusiasm and energy are released by faculty, students and administrators. However, the hard work of implementation requires dedication and commitment to change - in the role of faculty, in course content and format, in teaching methods, in departmental and faculty interaction, and in the modification of administrative and logistical support systems. An appreciation for the scope of the change can be gained by realizing that Major Qualifying Projects, Interactive Qualifying Projects, and Competency Examinations must be provided for the approximately 400 degree candidates each year. A partial listing of institutional forms and support structures which have been implemented are given below.[2]

School Calendar - Changed from two semesters to four terms each academic year. This permits concentration on fewer courses (going from four to three) and provides much greater flexibility for project work.

Advising System - An extensive system of faculty advisors was developed to help students plan their individual programs. The system is presided over by a Dean of Academic Advising and a faculty committee.

Project Center - Headed by the "Dean for Projects" this center was established to provide help to students in virtually every aspect of project work. It acts in a facilitation mode between students, faculty and outside agencies and maintains an active project network.

Washington Project Center - An off-campus academic base was established for public sector project work in federal agencies as described earlier.

Grading System - Changed from the traditional numerical or letter grades to the three basic grades of Acceptable, Acceptable with Distinction, or No Record. The idea is to encourage study for the sake of understanding by deemphasizing detailed grades.

Division of Interdisciplinary Affairs - Created primarily to provide resources and program opportunities for faculty and students to work on interactive, multi-disciplinary projects.

T.V. Studio - A major facility was equipped with modern recording and playback equipment. A campus-wide, closed-system T.V. network supports all instructional modes.

Library - Expanded holdings in books and especially nonprint materials such as government publications. Extensive videotape library and individualized viewing equipment. The library also maintains over 2500 completed MQP and IQP project reports.

Computer Facilities - A first rate regional computing center with expanded hardware and services. Two large computers service records and business needs and a time sharing system supports learning and project requirements. A computer-controlled student registration system assists program planning and faculty advising.

Transfer of Knowledge - Some basic courses shifted to a self-paced, mastery-oriented format using Individually Prescribed Instruction (IPI), learning manuals, T.V. tapes, computer programs and other teaching aids. WPI faculty have made over 1,200 videotapes as integrated supplements to ongoing courses and the library registers over 15,000 student viewings a year. Advanced students are encouraged to tutor other students under faculty supervision.

Clearly, to fully implement such a program an institution must possess flexibility, the resourcefulness to adapt to new and unforeseen circumstances, and the willingness to adopt new academic support structures.

Relation to Lifelong Learning

Underlying the WPI Plan is the fundamental premise that education should last a lifetime in the sense that it should promote learning how to learn. This premise is both explicit and implicit in the four major degree requirements, as well as in the institutional academic program support structures. It is recognized that the knowledge explosion and the pace of technological change combine to create an almost impossible task for traditional education.[3,7] As we try to fit more and more into a highly structured curricular format we reach the limit of diminishing returns.[5] In addition to the obstacles created by the obsession to dispense ever increasing content, there is the educational imperative to prepare the student for professional practice and leadership.[6] Engineering education must seriously examine the career requirements of its graduates and it should adjust its programs to support important professional functions.[8] Certainly engineering competence and expertise are necessary. However, there are other ingredients which are vitally important, yet traditionally they are given very little attention. The most important of these are:

- Exposure to practice including the post-technical functions,
- Management of human resources,
- Economics and the role of finance,
- Communications,
- Initiative and creativity,
- Interpretation to the nonspecialist and public sector.

An educational imperative resides in these and related areas, and it is by incorporating such material in our education that we will give meaning to the professional dimension. Again the WPI Plan attempts to incorporate each of these professional components in its program. In so doing, it integrates important lifelong learning considerations in the engineering undergraduate experience.

Individual responsibility for learning, required professional experience, and performance criteria for graduation are the key ingredients of the undergraduate educational program at WPI. In concept, they are fully consistent with the objectives of lifelong learning and they provide a base for a lifetime commitment to continued learning in support of human development. WPI has introduced a major educational reform by asserting in new form the basic unity of knowledge and practice. Professional engineering schools and institutes have a great opportunity in adapting this concept of binary education to the unfolding advance in man's knowledge and social development.

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Editors Note

Because paper was changed at last minute picture and biographical sketch of Francisco Beltran precedes his paper which begins on page 250.

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THE CONTINUING EDUCATION IN THE SECRETARIAT OF HUMAN SETTLEMENTS AND PUBLIC WORKS OF MEXICO

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Todo ser humano inevitablemente requiere de un proceso de educación continua, debido a que vivimos en un mundo que cambia constantemente, los individuos tienen que considerar su adaptación a nuevos aspectos de recreación, cultura y superación personal.

El desarrollo científico y tecnológico plantea la necesidad de mantenerse al día en técnicas y métodos que se modifican a velocidades extremadamente aceleradas.

Evidentemente los seres humanos deben mantener una actitud de educación permanente, que no sólo debe ser característica de profesionales o de beneficiarios de estudios universitarios, ya que es obligación ineludible tanto personal como a nivel institucional, evolucionar y alcanzar día con día metas más elevadas que conduzcan a la superación del individuo, de su familia, del grupo social al que pertenece y del país en el que habita.

La evolución gradual en el desarrollo socioeconómico de la República Mexicana motivó que, desde el año de 1925, la entonces Comisión Nacional de Caminos, actualmente Secretaría de Asentamientos Humanos y Obras Públicas, propicie y patrocine la formación de especialistas en las diversas actividades de la Ingeniería que, por las funciones que le competen, debe llevar a cabo a nivel nacional. Es así como en el año de 1959 bajo la denominación de Secretaría de Obras Públicas, patrocinó cursos de especialización en vías terrestres que se efectuaron por conducto de la Facultad de Ingeniería de la Universidad Nacional Autónoma de México. Estos cursos se impartieron hasta 1972, año en que se implantó un programa de capacitación para todo el personal que integraba la mencionada Secretaría para lo cual se le dividió en tres grandes grupos: Obrero, Administrativo y Profesional; habiendo delegado el Titular del Ramo en el Subsecretario de Obras Públicas, la responsabilidad de llevar a cabo el programa correspondiente al grupo profesional. Durante el período de 1970-1976, el mencionado programa de capacitación a nivel profesional, incluyó 44 diferentes cursos impartidos a 6,129 asistentes. Dichos cursos se dividieron en:

a) Cursos para personal profesional de nuevo ingreso.

b) Cursos de actualización de profesionistas con elevado índice de obsolescencia del conocimiento.

c) Cursos de especialización.

d) Cursos para apoyar el desarrollo de maestrías.

Every human being inevitably requires of a continuing education process, due to the fact that we live in a continously changing world; individuals must consider their adaptability to new aspects of recreation, culture and personal improvement.

The scientific and technological development makes it necessary to be up-to-date on techniques and methods that are being modified at extremely accelerated speeds.

Obviously, human beings must keep a permanent education attitude, which must be not only characteristic of professionals or of beneficiaries of university studies, because evolving and reaching day after day higher goals that lead to the improving of the individual, his family, the social group he belongs to, and the country he lives in, is an unavoidable duty both in personal and institutional levels.

The gradual evolution in the socio-ecohomic development of the Mexican Republic, caused that since 1925, the Highway National Commission nowadays Human Settlements and Public Works Secretariat (Secretaría de Asentamientos Humanos y Obras Públicas), favored and sponsored the formation of specialists on the different activities of Engineering, which carries out specific functions of specialists on the different activities of Engineering, which carries out specific functions at national level.

For this reason, in 1959, under the name of Public Works Secretariat (Secretaría de Obras Públicas), it sponsored specialization courses on Road Design, held through the Engineering Faculty of the Universidad Nacional Autónoma de México. These courses were given until 1972, year in which a training program for all the personnel integrating the above-mentioned Secretariat was established.

This program was divided in three great groups: Workers, Administrative Personnel and professionals; the Minister delegated on the Under-Minister of Public Works, the responsability of carrying out the program corresponding to the professional group. During the period 1970-1976, the mentioned training program at professional level, included 44 different courses given to 6129 attendants. Such courses were divided in:

a) Courses for profesional personnel recently hired.

b) Actualization courses for professionals with high rate of knowledge obsolescence.

c) Specialization courses.

d) Courses to assist in masterships development.

Por la importancia que ha tenido el *curso de actualización de conocimientos*, se describen brevemente las características y resultados obtenidos en los 16 grupos que, con una asistencia de 352 profesionales, se han integrado a la fecha. Esta se considera que es una de las acciones más positivas que al igual que el curso de especialización en Vías Terrestres, ha permitido cubrir una de las grandes necesidades de recursos humanos que es la formación de los cuadros directivos.

Este curso, que se lleva a cabo con la colaboración del Centro de Educación Continua de la División de Estudios Superiores de la Facultad de Ingeniería de la Universidad Nacional Autónoma de México, tiene un contenido curricular que fue integrado a partir de un censo de necesidades a cubrir, realizado con la ayuda de los directivos de la Secretaría y de la Institución Educativa mencionada, y analizado mediante un modelo de Ingeniería de Sistemas, que permitió optimizar los resultados.

El programa de referencia no se opera con un subsidio especial, sino con fondos y recursos federales de la partida Estudios y Proyectos, del presupuesto asignado a la Secretaría.

Los requisitos que se establecieron para seleccionar a los posibles asistentes al curso, fueron los siguientes:

1– Haber estudiado en una institución de educación superior, en la rama de Ingeniería Civil.

2– Tener una edad mínima de 26 años y máxima de 55.

3– Ser propuesto por su jefe inmediato como candidato al curso.

4– Ocupar el cargo de Residente de Obras, su equivalente o jerarquía superior.

5– Tener más de 5 años de haber finalizado los estudios prosionales.

6– Tener más de dos años de haber ingresado a la Secretaría.

El objetivo de este curso ha sido el de propiciar la actualización de conocimientos de los asistentes, tanto en sus aspectos técnicos como en el de relaciones humanas, a través de una información transmitida por expertos en cada una de las materias que integran el curso, las cuales se imparten en forma teórico-práctica, programando ejercicios y problemas que los asistentes desarrollan individualmente o en grupo.

La evaluación del trabajo personal se ha hecho a través de la participación de los asistentes en las diferentes actividades docentes, sin asignar calificaciones específicas, ya que al término del curso se les otorga un diploma de asistencia, con el que acreditan la currícula del curso.

Como esta evaluación es subjetiva, al concluir el XIV grupo se estimó conveniente realizar una investigación psicopedagógica* con

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* ETAPA: 1

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Due to the importance of the actualization knowledge course, the characteristics and results obtained from the 16 groups integrated up to the present time, with an attendance of 352 professionals, are briefly described. This is considered to be one of the most positive actions which, as well as the specialization course on Road Design, has allowed to cover one of the most important needs of human resources, which is the formation of executive staff.

This course is carried out with the cooperation of the Center for Continuing Education of the Division of University Studies of the School of Engineering of the National Autonomous University of Mexico (Centro de Educación Continua de la División de Estudios Superiores de la Facultad de Ingeniería de la UNAM) it has a curricular content which has been integrated selecting previously the needs that had to be covered and realized with the assistance of the Directors of the Secretariat and of the above mentioned Education Institution, and analized through an engineering system model which enabled the optimization of results.

Such program is financed with funds and federal resources of the Studies and Projects assignment, from the budget assigned to the Secretariat and not as a special subsidy.

The requirements established to select the possible attendants are the following:

1– To have followed studies in a superior educational institution, in the Civil Engineering branch.

2– Minimum age of 26 and maximum of 55 years.

3– To be proposed by his inmediate commanding officer as a candidate to the course.

4– Have the charge of Resident of Public Works, its equivalent or a more important charge.

5– Five years at least should have passed after completion of his professional studies.

6– Two years or more of having entered the Secretariat.

The objectives of this course have been to favor the knowledge actualization of the attendants, both in technical aspects and in human relations, through an information transmitted by experts in each one of the subjects that integrate the course, which are given in a theoretical-practical way, by programming exercises and problems to be solved by the attendants individually or in a team.

The evaluation of the personal works has been achieved through the participation of the attendants in the different teaching activities, without assigning specific notes, because at the conclusion of the course the attendants receive a diploma, which accredits their attendance.

As the mentioned evaluation is merely subjective, at the conclusion of the XIV group it was considered convenient to realize a psychopedagogic* investigation, in order to accomplish an effi-

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objeto de llevar a cabo una retroalimentación eficaz que permitiera hacer los ajustes al contenido y dosificación de la enseñanza. Los resultados obtenidos condujeron a las recomendaciones siguientes:

1– Se requiere sistematizar los programas de estudio específico y los objetivos de aprendizaje y comunicarlos oportunamente a los estudiantes.

2– Aplicar constantemente evaluaciones.

3– Dividir los cursos en unidades.

4– Orientar la actuación de los profesores frente al grupo, de tal manera que se logre una mayor participación de los estudiantes.

5– Sistematizar los procedimientos de supervisión para mejorar la retroalimentación y motivación de los participantes.

Asimismo, se investigó entre todos los participantes, profesores y alumnos, al término de cada uno de los cursos:

a) tamaño ideal del grupo;

b) duración de la currícula;

c) intensidad de la dosificación;

d) opinión sobre la eficiencia y eficacia del sistema.

Los resultados indujeron a:

1– Reducir el número de materias, de 22 (Cuadro No. 1) a 17 (Cuadro No. 2).

2– Reducir el número de horas de exposición, de 480 a 325.

3– Modificar el sistema de inmersión, reduciendo la dosificación de la enseñanza de 8 a 6 horas diarias con trabajos y estudios a realizar fuera de las aulas universitarias.

4– Robustecer el contenido de las materias del campo humanístico que tuvieron mayor aceptación.

En la metodología se utilizaron técnicas heurísticas para la valuación tanto por parte de profesores y alumnos, como por parte de los jefes inmediatos que reportan modificación de actitud y eficiencia en el trabajo.

Conviene destacar en la experiencia que nos ocupa, por ser también un caso único, el curso de *Tecnología del Concreto Hidráulico*, cuyo contenido se definió después de llevar a cabo un censo de los defectos y errores detectados en algunas obras que fueron contratadas por la Secretaría y reportados por supervisores de residentes, residentes de zona y jefes de departamento.

En la investigación curricular de este curso intervinieron seis especialistas para cuya selección fue requisito que contaran con más de diez años de experiencia profesional, más de cinco años de experiencia docente y que estuvieran al tanto de los últimos avances en la materia.

El material didáctico utilizado incluyó apoyos audiovisuales que facilitaron la exposición de los profesores, logrando así una continuidad en el contenido y una dosificación de la enseñanza bajo el

cient backfeeding that would allow to make the necessary adjustments to the content and dosification of the teaching. The obtained results led to the following recomendations:

1– Specific study programs and learning objectives. Should be systematized and transmitted to the students in due time.

2– Evaluations should be constantly applied.

3– The courses should be divided into units.

4– The professors intervention towards the class should be oriented in order to obtain a wide participation of the students.

5– Supervision procedures should be systematized in order to improve the attendants backfeeding and motivation.

At the conclusion of each course, an investigation among all attendants, professors and trainees was made concerning:

a) the optimum number of attendants to each group;

b) the optimum duration of each course;

c) the optimum intensity of the information to be proportioned;

d) opinion in regard with the effectiveness and the efficacy of the system.

The results conducted to:

1– Reduce the number of subjects, from 22 (Table No. 1) to 17 (Table No. 2).

2– Reduce the number of class hours, from 480 to 325.

3– Modify the immersion system, reducing the dosification of teaching from 8 to 6 hours daily, with works and studies to be realized outside the university classrooms.

4– Strengthen the subjects content in the humanistic field that had more acceptance.

In the methodology, heuristic techniques were for the evaluation practiced by professors and students, as well as by the immediate commanding officers who reported a modification concerning the attitude and efficiency in work.

It is convenient to emphasize the course on *Hydraulic Concrete Technology*, because the experience that occupies us, is also a sole case, which content could be only defined after having achieved a census in regard with the defects and mistakes detected in some works contracted by the Secretariat and reported by resident supervisors, zone residents and heads of offices.

Six specialist took part in the curricular investigation of this course, and for their selection it was required to have at least 10 years of professional experience, more than 5 years of teaching experience and to be up-to-date in the last developments on the subject.

The didactic material used included audiovisual means, which facilitated the professors expositions and allowed the continuity of the content and a better dosification of the teaching under the sistema de inmersión, con objeto de impartir este curso en dos días, con 8 horas diarias de exposición directa.

Se seleccionaron seis regiones del país para integrar grupos con una asistencia mínima de 40 alumnos y máxima de 75.

La asistencia total registrada en las seis regiones del país fue de 275 alumnos.

Para evaluar en forma más consistente el resultado de cursos de esta naturaleza, se llevó a cabo una investigación psicopedagógica[*] en dos de los grupos formados. A la mitad de asistentes del primer grupo, se les aplicó una preprueba y a la totalidad una posprueba. Con base en los resultados, se pudo observar que la mitad del grupo que no fue sometido a la preprueba, tuvo un incremento de conocimientos del 26% , mientras que a los que sí se les aplicó la preprueba, tuvieron un incremento del 48% .

En el segundo grupo, al que en su totalidad se aplicó la preprueba y la posprueba, se reportó un incremento de información del 59% . La opinión de los asistentes, respecto a este curso y a los instructores, se vertió en formas con escala 1 a 5 y el resultado de ésta, para los factores mencionados, fue el siguiente:

a) El curso lo consideraron positivo, ya que lo calificaron cerca del puntaje 5.

b) La cantidad de trabajo se mantuvo cerca del puntaje 3 (regular), aun cuando la tendencia era clasificarlo como "demasiado".

c) La clasificación, respecto a la rapidez con la que se impartió la información, en general, fue calificada como "demasiado rápida".

En un nivel más avanzado se halla el *Taller Intensivo en Tecnología de la Enseñanza*.[†] El objetivo general de este taller fue el familiarizar a los participantes con los procedimientos docentes más recientes y de eficacia evaluada y, adiestrarlos en el uso sistemático de dichos procedimientos. Especialmente, los propósitos fueron los de entrenar a los participantes en: la confección de objetivos de enseñanza para sus respectivas especialidades, el uso adecuado de principios del aprendizaje en la elaboración de materiales de estudio, el incremento del rendimiento del alumno con base en algunas características de la interacción personal, el uso de una distribución cuidadosa de las actividades docentes en el tiempo y algunas técnicas de organización conceptual en exposiciones orales, entre otros.

En su desarrollo se elaboraron dos tipos de presentaciones audiovisuales. Las primeras contenían una serie de descripciones e instrucciones para la confección adecuada de objetivos instruccionales eficaces.

Las segundas comprendían la descripción programada y ejemplificada de la aplicación de diez estrategias de alta eficacia para las exposiciones orales en la docencia y en la preparación de cursos,

immersion system; this enabled the course to last only 2 days, with 8 hours of daily direct exposition.

To evaluate in a more consistent way the results of this kind of course, a psychopedagogic investigation[*] was carried out in 2 of the groups formed. A previous test was applied to one half of the attendants of the first group and an after-test to all of them. Based upon the results obtained, it was possible to observe that the half of the group that was not submitted to the previous test had increased their knowledge in 26% , while those who had been submitted to it increased in 48% .

In the second group, which was totally submitted to the previous and after tests, a 59% of knowledge increase was reported. The attendants opinions in connection with this course and with the professors, was recorded in sheets. A range from 1 to 5 was established for calification. The following results were obtained:

a) The course was considered positive, because it was rated near 5;

b) The amount of work was maintained near 3 (regular), even though the trends were to classify it as "to much".

c) The classification, in regard with the velocity with which the information was given, was classified, in general, as "to rapid".

In a more advanced level, we find the "*Intensive Teaching Technology Workshop*".[†] The general objective was to familiarize the attendants with the most recent and efficient teaching procedures and to train them on the systematic use of such procedures. Specially, the goals were to train the attendants in: the confection of teaching objectives for their respective specialities, the adequate use of the learning principles for the setting up of study materials, the increasing of the students improvement based upon some characteristics of personal interaction, the use of a careful distribution of teaching activities in time, and some techniques of conceptual organization in oral expositions, among others.

In its development, two different types of audiovisual presentations were carried out. The first ones contained a series of descriptions and instructions for an adequate elaboration of efficient instructional objectives. The second ones included the programmed description with examples of the application of the ten highly efficient strategies for the oral expositions of the teaching and for

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[*] ETAPA III: IPSCSOP – 76
EVALUACION CURSO CONCRETO HIDRAULICO PARA RESIDENTES DE OBRA
Laura Hernández G., Juan José Sánchez S. y Gabriel Vázquez F.

[†] TALLER INTENSIVO EN TECNOLOGIA DE LA ENSENANZA – IPSCSAHOP – 78
Dr. Juan José Sánchez Sosa, M. Lechuga Besné, A. González Costa, A. Vite Sierra y J. Martínez Guerrero.

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Dichas presentaciones se complementaban con textos y lecturas, así como con listas (guías) de preguntas de estudios para cada porción del curso.

La figuras de la 1 a la 12 muestran el rendimiento de los asistentes del curso intensivo a las pre- y postevaluaciones sobre los dos temas centrales del taller. Dichos temas se referían, en primer lugar, a la elaboración de objetivos de enseñanza y, en segundo, a la solución de problemas instruccionales en exposiciones orales, planteados en examen. Las figuras muestran el porcentaje de respuestas correctas para cada sujeto de la manera en que las registraron dos observadores, en forma tal que las gráficas muestran, además del rendimiento en porcentaje, una estimación real de la confiabilidad en la calificación.

En todos los casos, tanto para el tema de objetivos como para el de estrategias, hubo porcentajes de ganancias superiores al 45% . De hecho, todas las calificaciones de ganancia de la pre- a la postevaluación, excepto una, fueron superiores al 60% ; el rango de variación aproximada de estos valores de ganancia fue de 40 a 90% . Aquellas gráficas que sólo muestran los valores correspondientes a alguno de los registros, ya sea pre- o postevaluación, se refieren a asistentes del curso que interrumpieron sus actividades en por lo menos media sesión. Por esta razón no se encuentran disponibles los datos de rendimiento de dichos sujetos.

De esta manera, la diferencia entre el rendimiento antes de la exposición de los asistentes al curso intensivo, y después de ésta, fue superior al mencionado 40% , pero en la mayoría de los casos esta diferencia superó al 60% llegando en muchos de ellos al 80% . Estos resultados se refieren a la habilidad que adquirieron los participantes para sugerir, bajo condiciones específicas, la aplicación de procedimientos de alta eficacia docente y la confección de objetivos instruccionales aplicados a problemas docentes en el área de la Ingeniería. Las figuras que muestran dichos resutados contienen gráficas elaboradas para cada sujeto.

En las siguientes diapositivas se ilustran brevemente los diversos eventos de capacitación y desarrollo de personal profesional, llevados a cabo en esta Secretaría durante los últimos ocho años. En cada diapositiva se advierte el nombre del curso, las materias que lo integran y los objetivos educacionales o instruccionales que se persiguen. En su caso, se consignan los principales medios y apoyos didácticos.

En los anexos de este documento se reseñan, en forma global, los aspectos gráficos y los textos que aparecen en las diapositivas.

Los anterior se ha desarrollado considerando que, de acuerdo con los señalamientos del Titular de esta Secretaría y del Subsecretario de Obras Públicas que, como indicamos, es el encargado de la capacitación a nivel profesional, la educación continua no es una prestación, sino una obligación de todos, de funcionarios y de personal, para llevar hasta las últimas consecuencias su sentido profundo y humanista en beneficio de todos.

CONCLUSIONES

Los resultados obtenidos por las observaciones directas y por los registros de opinión de los participantes, así como los mostrados por las evaluaciones, señalan consistentemente que los cursos del programa de capacitación a nivel profesional, son altamente efectivos en el cumplimiento de sus objetivos, ya que los participantes adquieren destrezas de vital importancia para las labores que les son encomendadas. Conviene enfatizar que las actividades y procedimientos que se llevaron a cabo se derivaron originalmente de in-

the preparation of the course. Such presentations were complemented with texts and readings, as well as with lists (guides) of questions for each part of the course.

In figures 1 to 12 the improvement of the attendants to the intensive course in the previous and after evaluation concerning the two main subjects of the workshop is shown. These subjects were related, first, to the confection of the teaching objectives and, second, to the solution of the instructional problems in oral expositions, stated in the test. The figures show the percentage of correct answers for each individual, as they were registered by two observers, in such a way that the diagrams show, besides the percentage of the improvement a real estimation of the reliability in grading.

In all cases, both for the objectives and the strategies subjects, there were imorovement percentages higher than 45% . In fact, all the improvement qualifications from the previous to the after evaluation, except one, were higher than 60% ; the approximate variation rate of this improvement was from 40 to 90% . The diagrams that only show the values corresponding to one of the registers, either previous or after evaluation, refer to the attendants to the course that interrupted their activities for at least half of the session; for this reason there are not available data on their improvement.

In this way, the difference among the improvement before and after the exposition of the attendants to the intensive course was higher than the 40% mentioned, but in most cases this difference exceeded 60% , reaching in many of them 80% . These results refer to the obtained ability of the attendants to suggest, under specific conditions, the application of highly efficient teaching procedures and the confection of instructional objectives applied to teaching problems in the Engineering area. The figures showing such results contain graphics constructed for each individual.

In the following slides the different training and development of professional personnel events, carried out by this Secretariat during the last 8 years can be briefly observed.

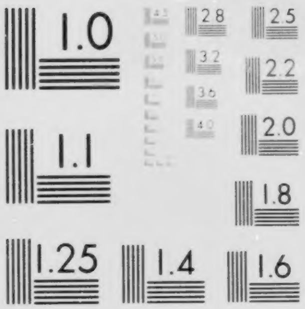
Each slide shows the name of the course, the subjects that integrate it and the educational or instructional objectives that are followed. When possible, the proper main means and didactic supports are consigned.

In the annexes to this document, the graphic aspects and the slide texts are explained in a general way.

The previously exposed idea have been developed considering that, in accordance with the appointments of the Minister of this Secretariat and of the Under-Minister of Public Works, who, as mentioned, is the person in charge of the training at a professional level, the continuing education is not a personal benefit, but an obligation to all, executives and personnel, to be carried out until the last consequences, to get its deep and humanistic sense in benefit of everybody.

CONCLUSIONS

The results obtained from the direct observation, the attendants opinion and the evaluations, show, in a consistent way, that the training program courses at a professional level are highly efficient in accomplishing their goals, and furthermore, the attendants acquire essential skills, which are very important for the work they have to develop. It has to be emphasized that the activities and procedures that were carried out, originally derived from methodolo-


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

vestigaciones de alta calidad metodológica, que señalaban en primera instancia, tanto su eficacia en la producción de resultados profesionales como en la optimización eficiente de los recursos en la instrucción a nivel profesional y superior.

Todos los cambios registrados en los participantes, antes y después de los cursos, produjeron importantes ganancias en las categorías definidas y en las habilidades adquiridas.

Cabe mencionar que en el curso de actualización de conocimientos, la convivencia de elementos heterogéneos en edades, ha permitido que los jóvenes valúen, en forma más real, la experiencia de los ya maduros Ingenieros de más de 25 o 30 años de ejercicio profesional y, a su vez, éstos han aprendido a valorar el empuje de la juventud de las nuevas generaciones de Ingenieros.

Por otra parte, se confirmó que utilizar la capacidad instalada de las instituciones de educación superior, es más redituable que el instrumentar cursos en instalaciones que tengan que construirse o adaptarse dentro de las dependencias que pretenden llevar a cabo programas de capacitación, con lo que se logra un aprovechamiento óptimo, tanto de recursos materiales como de recursos humanos.

En el curso de Tecnología del Concreto Hidráulico, quedó demostrada la eficiencia de aplicación de pre- y postevaluaciones, ya que con esto se logró un mayor incremento en la información de los asistentes. Por otro lado, al utilizar terminología de nueva creación y el concepto de opiniones de patología estructural, además de servir como elemento nemotécnico, reafirmó el criterio para la aplicación de conocimientos al evaluar las formas correctas e incorrectas que pueden producir, la seguridad o la falla de una estructura, tal como se mostrará en el audiovisual que se presenta al conluir la lectura de las siguientes.

RECOMENDACIONES

1— Aplicar en cualquier curso que se imparta, una prueba, a inicio y la misma al finalizar.

2— Tratar de implantar un sistema tal, que a través de las investigaciones psicopedagógicas, permita que el alumno se enfrente a situaciones similares a las reales y así poder, de antemano, incluir elementos más técnicos que eleven la eficiencia en la toma de decisiones, esto es, instrumentar simuladores.

3— Destinar recursos suficientes para propiciar la educación permanente de los colaboradores de las diversas instituciones que tienen encomendados trabajos de Ingeniería.

4— Propiciar la investigación psicopedagógica como retroalimentación a los cursos que se implanten.

5— Insistir en la conveniencia de capacitar y actualizar a los profesores de cualquier curso.

gic high quality investigations resulted efficient to produce professional results and to optimize the means of teaching at a professional and higher studies level.

All changes recorded in the attendants, after the courses, produced important improvements in the acquired skills, for personnel in all levels.

It has also to be mentioned that during the course of knowledge actualization, the living together of individuals having very different ages, has allowed the young generation to actually appraise the Engineers with 25 to 30 years of professional experience, and these Engineers have learned to appraise the energy of the new generation.

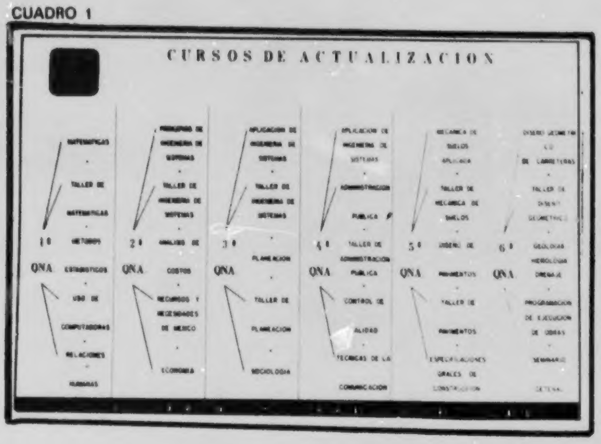
On the other hand, it has been confirmed that it is more convenient to give the courses in the already installed capacity of the superior education institutions, than to adapt or construct new installations to carry out training programs, because in this way an optimum use of material and human resources is allowed.

During the course on *Hydraulic Concrete Technology*, the efficiency of the previous and after evaluations could be settled, because they made possible to increase the knowledge of the attendants. On the other hand, the use of new terminology and the introduction of the concept of structural pathology reaffirmed the criteria for the knowledge application, because it permitted to evaluate the correct and incorrect building methods that lead to the safety or failure of a structure, as will be shown in the audiovisual that will be presented after the reading of the next recommendations:

RECOMMENDATIONS:

1. In every course, apply an examination at the beginning and at the conclusion of the course.
2. Try to introduce a system that, through psychopedagogic investigations, enables the trainee to face situations similar to the actual ones, in order to include, beforehand, more technical elements, which improve the efficiency of the decisions to be taken, i.e., to instrument simulators of actual conditions with results evaluation in order to take decisions.
3. Assign sufficient resources to enable the continuing education of the co-workers of the different institutions concerned with Engineering works.
4. Favor psychopedagogic investigations as a backfeeding to the forthcoming courses.
5. Insist on the convenience of training and actualizing the professors of any course.

CUADRO 1

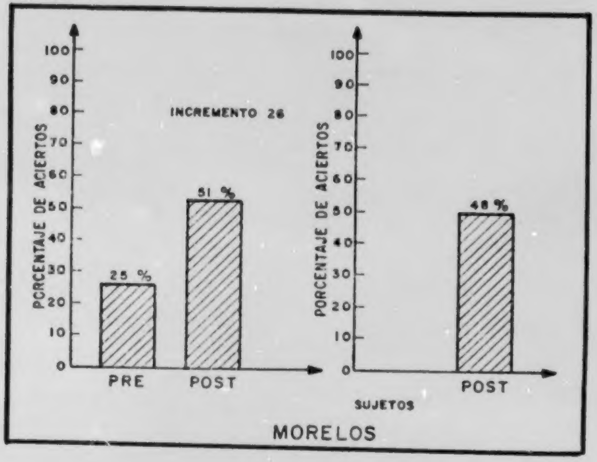

CURSOS DE ACTUALIZACION
1° QNA
MATEMATICAS
TALLER DE MATEMATICAS
METODOS ESTADISTICOS
USO DE COMPUTADORAS
RELACIONES HUMANAS
2° QNA
PRINCIPIOS DE INGENIERIA DE SISTEMAS
TALLER DE INGENIERIA DE SISTEMAS
ANALISIS DE COSTOS
RECURSOS Y NECESIDADES DE MEXICO
ECONOMIA
3° QNA
APLICACION DE INGENIERIA DE SISTEMAS
TALLER DE INGENIERIA DE SISTEMAS
PLANEACION
TALLER DE PLANEACION
SOCIOLOGIA
4° QNA
APLICACION DE INGENIERIA DE SISTEMAS
ADMINISTRACION PUBLICA
TALLER DE ADMINISTRACION PUBLICA
CONTROL DE CALIDAD
TECNICAS DE LA COMUNICACION
5° QNA
MECANICA DE SUELOS APLICADA
TALLER DE MECANICA DE SUELOS
DISEÑO DE PAVIMENTOS
TALLER DE PAVIMENTOS
ESPECIFICACIONES GRALES. DE CONSTRUCCION
6° QNA
DISEÑO GEOMETRICO DE CARRETERAS
TALLER DE DISEÑO GEOMETRICO
GEOLOGIA HIDROLOGIA DRENAJE
PROGRAMACION DE EJECUCION DE OBRAS
SEMINARIO

CUADRO 2

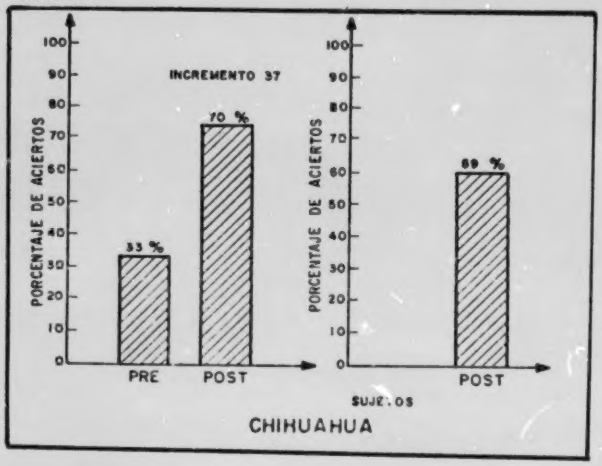
CURSO DE ACTUALIZACION PARA PERSONAL PROFESIONAL DE LA SECRETARIA DE ASENTAMIENTOS HUMANOS Y OBRAS PUBLICAS

HORA	1a. SEMANA	2a. SEMANA	3a. SEMANA	4a. SEMANA	5a. SEMANA	HORA	6a. SEMANA
9.00 10.30	TECNICAS DE LA COMUNICACION Oral Lic. Guillermo Orozco	HIDROLOGIA Ing. Francisco J. Paño R.	HIDROLOGIA Ing. Francisco J. Paño R.	MECANICA DE SUELOS Y TALLER Ing. Gabriel Moreno Pecero	MECANICA DE SUELOS Y TALLER Ing. Gabriel Moreno Pecero	9.00 10.00 10.30	INGENIERIA DE SISTEMAS Dr. Jesús Acosta Flores
11.00 11.30		INTRODUCCION A LA ECONOMIA Ing. Julian [illegible] Lic. José Antonio Ayon	INTRODUCCION A LA ECONOMIA Ing. Julian [illegible] Lic. José Antonio Ayon			11.00	
13.00 14.00 14.30	TECNICAS DE LA COMUNICACION Escrito	TALLER DE USO DE COMPUTADORAS Ing. Gustavo Argil Carrillo	TALLER DE USO DE COMPUTADORAS Ing. Gustavo Argil Carrillo	GEOLOGIA Ing. Alejandro Bello	CONTROL ESTADISTICO DE CALIDAD Ing. Felipe Lon Gómez	12.00 12.30 13.00 14.00 14.30	DISEÑO DE PAVIMENTOS Ing. Carlos Fernández Loaiza

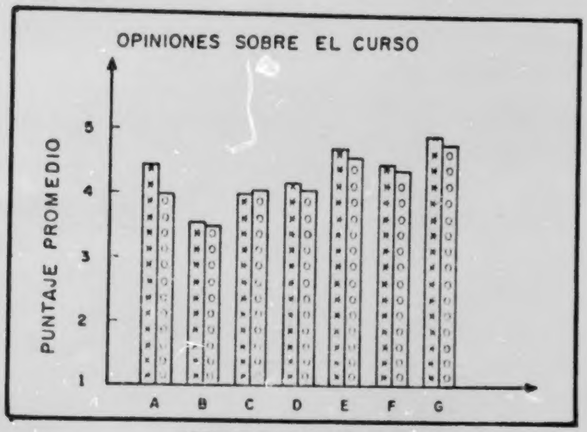
GRAFICA 1



GRAFICA 2



GRAFICA 3



GRAFICA 4

"COMO CLASIFICARIA..."

A. EL METODO DE ENSEÑANZA (1 = DEFICIENTE; 5 = EXCELENTE)
B. LA CANTIDAD DE TRABAJO (PARA EL ASISTENTE) (1 = POCA; 5 = DEMASIADA)
C. LA CANTIDAD APRENDIDA COMPARADA CON OTROS CURSOS (1 = POCA; 5 = BASTANTE)
D. EL RITMO DEL CURSO (1 = DEMASIADO LENTO; 5 = DEMASIADO RAPIDO)
E. EL CURSO LE OFRECE ESTRATEGIAS A SEGUIR EN SU TRABAJO PROFESIONAL (1 = MUY POCAS; 5 = BASTANTES)
F. EL CURSO HA MEJORADO SU EFECTIVIDAD PROFESIONAL (1 = MUY POCO; 5 = BASTANTE)
G. INCORPORARIA USTED EL CONTENIDO DEL CURSO A SU TRABAJO PROFESIONAL (1 = DEFINITIVAMENTE NO; 5 = DEFINITIVAMENTE SI)

CUERNAVACA ✱✱✱✱✱✱

CHIHUAHUA ○○○○○○

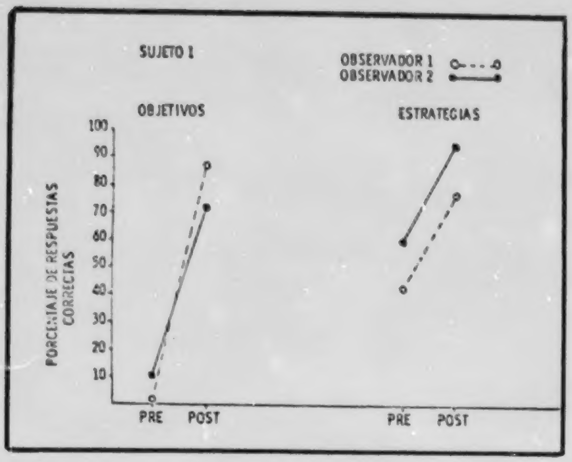


FIGURA 1

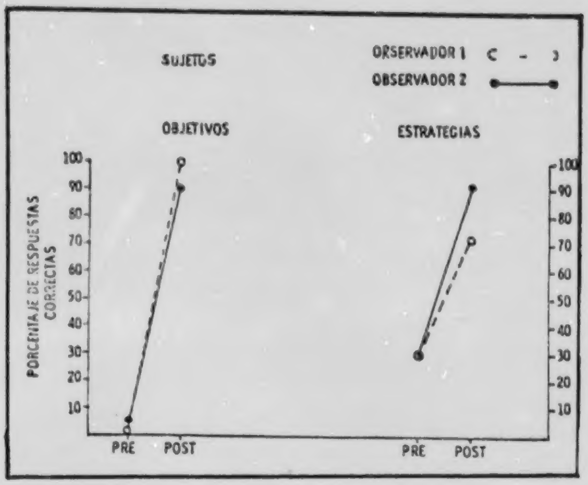


FIGURA 2

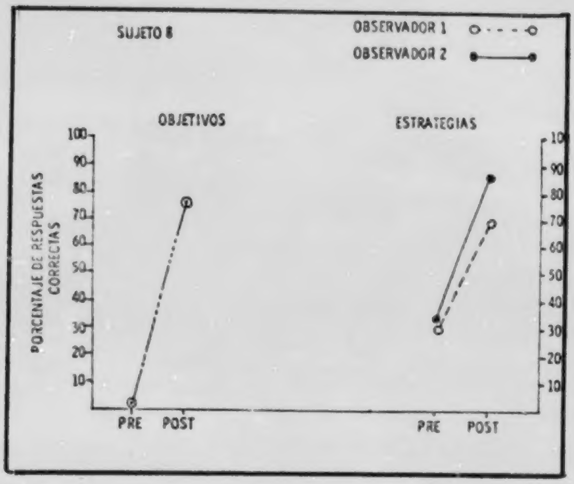


FIGURA 3

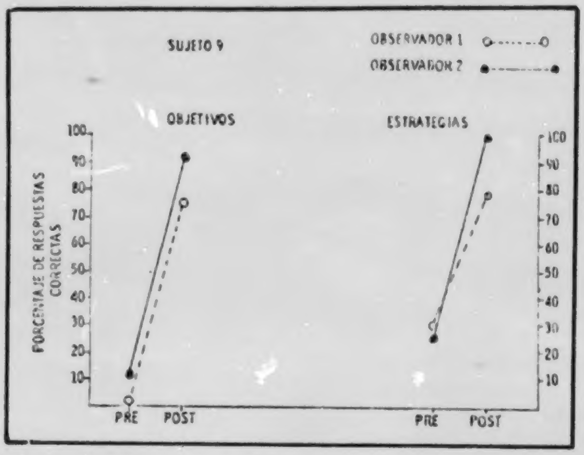


FIGURA 4

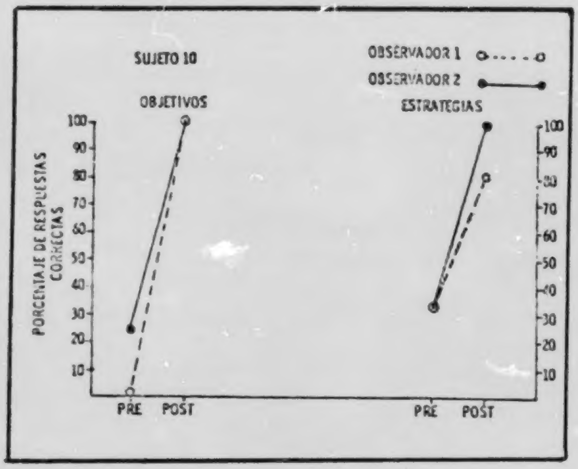


FIGURA 5

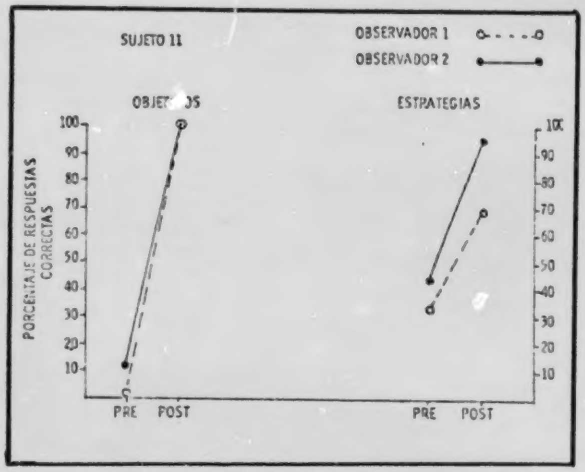


FIGURA 5

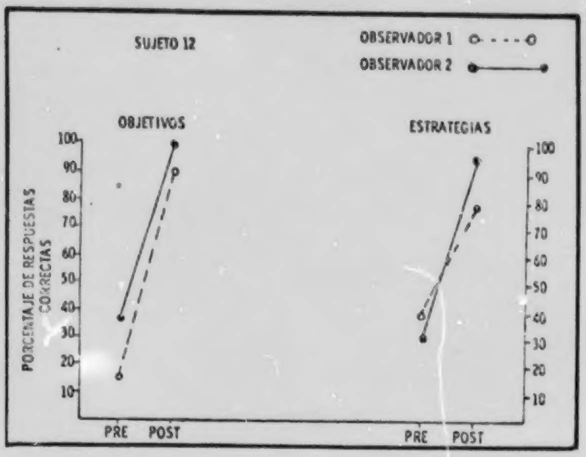


FIGURA 7

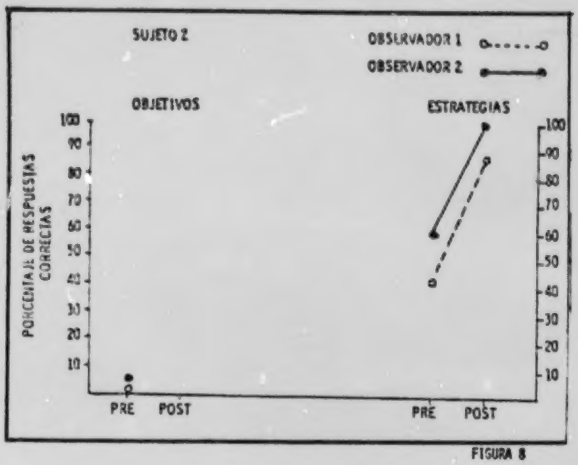


FIGURA 8

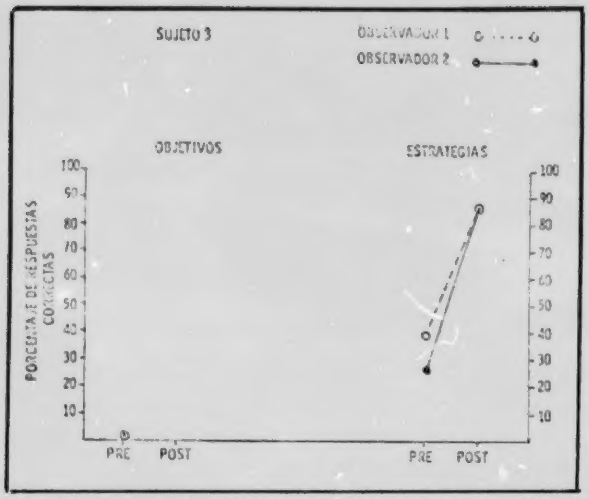


FIGURA 9

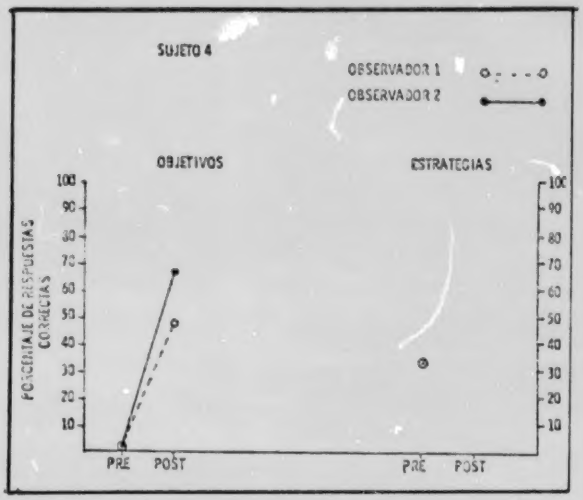


FIGURA 10

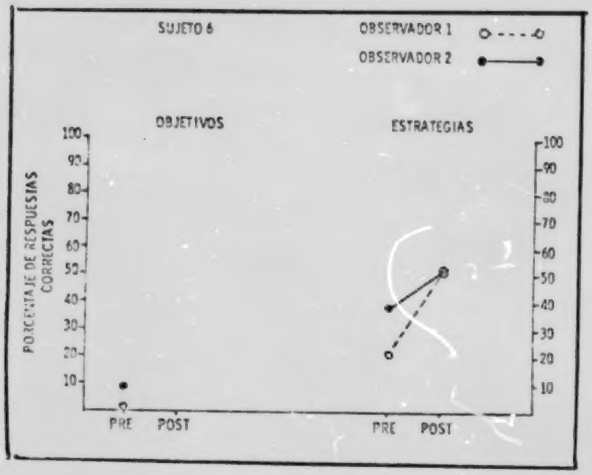


FIGURA 11

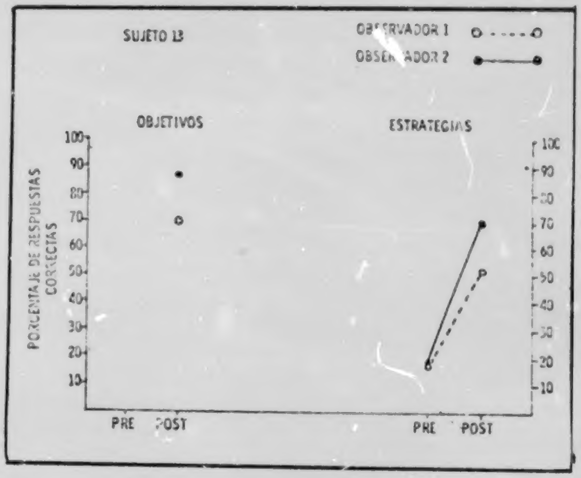


FIGURA 12

FIGURAS 13

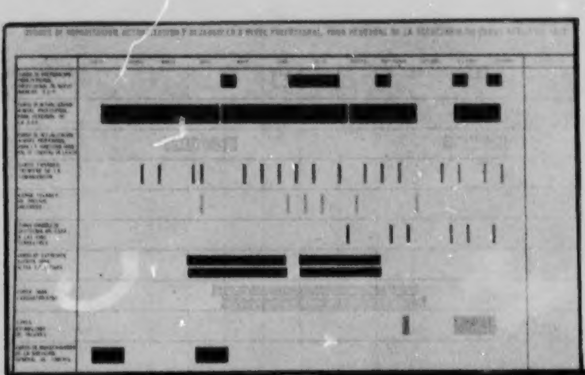


FIGURA 14

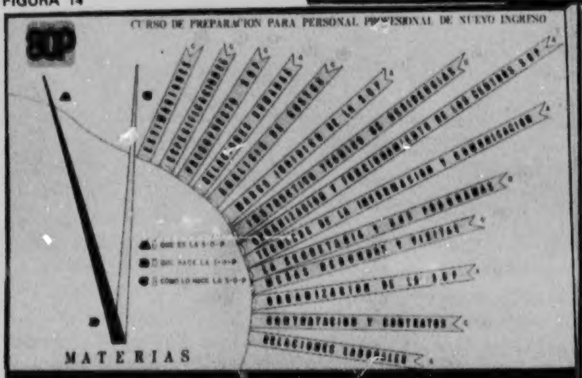
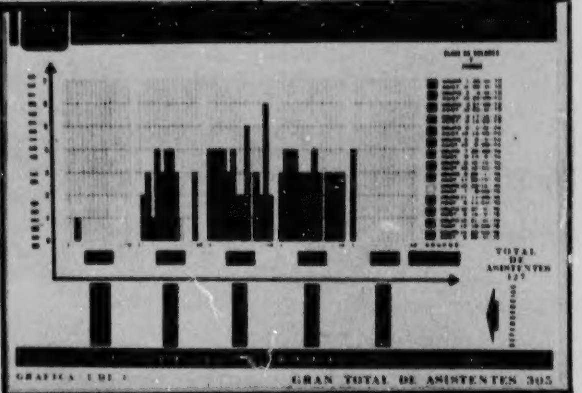

CURSO DE PREPARACION PARA PERSONAL PROFESIONAL DE NUEVO INGRESO
SOP
QUE ES LA S.O.P
QUE HACE LA S.O.P
COMO LO HACE LA S.O.P
ORGANIZACION DE LA SOP
CONTRATACION Y CONTRATOS
MATERIAS

FIGURA 15



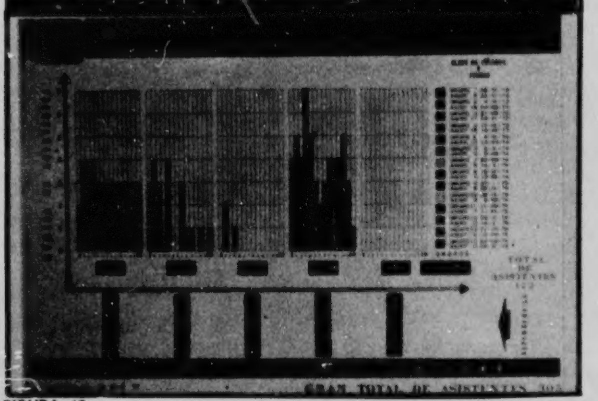


FIGURA 16

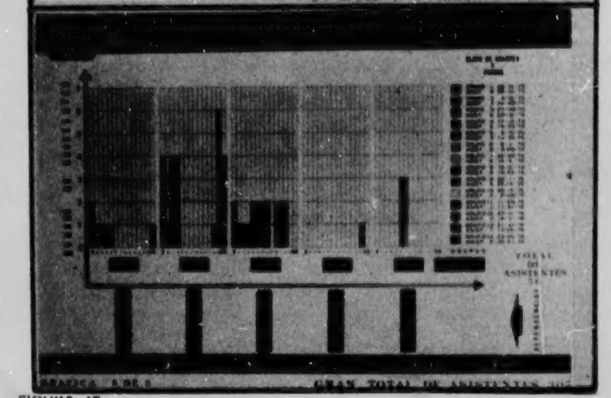
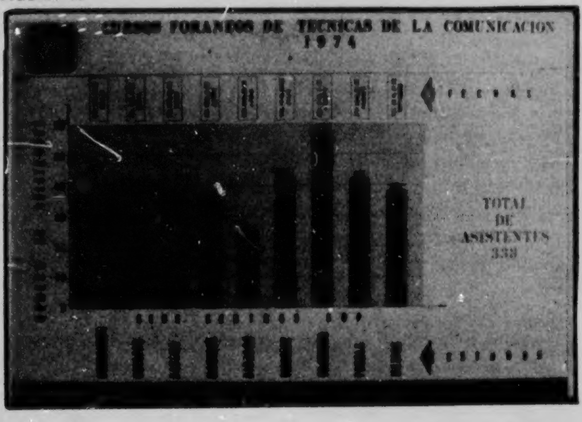


FIGURA 17



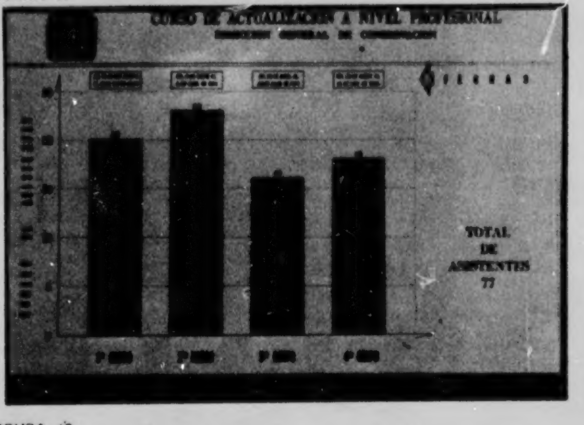


FIGURA 18

FIGURA 19

PROFESSIONAL REFERENCE PROGRAMS — KEEPING THE ENGINEER CURRENT IN HIS PROFESSION

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Summary

This paper describes a new approach to continuing professional education called the Preference™ or Professional Reference program, developed and offered by The MGI Management Institute, Larchmont, New York, U. S. A. The Professional Reference program uses the correspondence mode of instruction in a flexible format which permits the student to select his preferred areas of interest in the course and to carry out the Skill Development Exercises in any order he wishes. Typical course subjects include Effective Technical Project Management, Managing a Professional Practice, Land Development for Architects and Understanding Microprocessors Through Software Design.

1. Background

The correspondence course has always had one major advantage over the evening course, the seminar and any other educational program that requires attendance by the student. That advantage is flexibility. Unfortunately, in the past, the idea of flexibility was used much more effectively in the promotional materials for correspondence courses then it was in the actual course.

As long as the dictates of the correspondence school insist on sequential lesson-by-lesson completion of a course, flexibility is a myth. The only way an individual can ever be expected to complete an extensive multi-lesson correspondence course in sequence is by setting up a regular timetable for completing the lessons. If one accepts the correspondence course as adequate entry-level training -- and I do not -- then flexibility goes out the window, and a routine study schedule becomes essential. However, if we instead employ correspondence education as a means for providing continuing education for the professional who has completed his entry-level training, then not only is flexibility possible, but also it is an essential component of the experience.

MGI's Professional Reference Program begins with the assumption that the registrant in a continuing education correspondence course is the best judge as to what he or she wishes to learn, and when. The function of the Professional Reference Program then becomes to provide access to that learning whenever the student wants it. Here's how it works:

A typical Professional Reference Program consists of 6 to 8 sections, each perhaps 20 to 25 pages in length, with the entire course contained in a single loose-leaf binder. Each section covers several related topics. For example, one section of a finance course might begin with ten pages devoted to the balance sheet followed by another ten pages covering the profit and loss statement. At the end of the balance sheet sub-section, the student finds one or more Skill Development Exercises, which he can complete and send in for review and comment. These are realistic simulated situations in which the student is asked to deal with a specific managerial problem. He carries out the exercise in the form which he would use in a real situation -- a memo to a superior, a financial report or the like. He'll find similar Skill Development Exercises at the end of each sub-section of the course, with a total of 12 to 15 such exercises in a complete course.

At the end of his course binder, the student will find a comprehensive subject index. If the student is interested in the balance sheet, he simply looks up "balance sheet" in the index, finds the appropriate sub-section, reads the material, completes and sends in the Skill Development Exercise and he has his balance sheet understanding. Similarly, if his interest is in a sub-topic of the balance sheet, such as asset valuation or the difference between assets and liabilities, the index would refer him to the same section. Other topics related to finance would be covered in other sections of the course. In effect, the student has an instructor on his bookshelf, available to him when the student needs him. He is neither expected nor asked to complete the entire correspondence course. He is only told, "Here is your resource. Use it as you need it."

That, in a nutshell, is the philosophy of The MGI Management Institute and its Professional Reference Programs

2. The MGI Organization

The MGI Management Institute is today in its 11th year of operation. It's offices are located in Larchmont, New York, a suburb of New York City. MGI employs a staff of 15 people, whose functions range from registration of students, bookkeeping and handling of accounts receivable, to processing of student exercises, development of promotional materials and preparation of artwork and camera-ready copy for new courses. Executive functions are carried out by the writer and Gerard Cunningham, MGI's Vice President and Director of Operations. Our overall objective is to develop Professional Reference Programs for a wide range of engineers, architects, scientists and other professionals through their professional societies. MGI today has 20 sponsoring societies, among them the American Institute of Architects, the Institute of Electrical and Electronics Engineers, the American Society of Civil Engineers and the American Society for Quality Control. In addition to the engineering and architectural fields, MGI is currently active in developing continuing education Professional Reference Programs in medicine.

In addition to it's permanent staff, MGI employs a number of consultants to assist us in our course development and marketing activities and to assure the quality of our educational offerings. MGI also works with a wide range of authors on a royalty basis.

3. Need Analysis

Ten years ago, when MGI started, it offered only one course, "The Management Games Seminar" a course in corporate financial management in which the student managed a simulated company against competition entirely by correspondence. The course was initially offered to the New York area membership of the Engineering Management Society (then Engineering Management Group) of IEEE. Because of it's excellent reception by that group, IEEE decided to offer it nationally to its membership. Again, the response was excellent, with nearly 3,000 IEEE members enrolling in the course during the first year. Since my own background is in electrical engineering, I was aware from personal experience that electrical engineers -- and probably all engineers -- sorely lacked management training. However, that type of ad hoc research cannot be carried on indefinitely. Today, MGI carries out formal market surveys, to determine the continuing education desires of its sponsoring society members. These surveys begin with a brainstorming session attended by 10 to 15 individuals representing a cross-section of the society membership. The objective of this session is to generate as broad as possible a menu of continuing education topics. These topics then form the basis of a questionnaire which is sent to a random sampling of approximately 3,000 society members. The survey includes additional questions having to do with preferred learning styles (evening courses, one-day live seminars, correspondence courses and the like) and pricing limitations. The response to the survey, typically in the range of 15 to 20%, is tabulated by MGI and provided as a final report to the professional society. MGI uses the data to develop specific Professional References courses in high interest topics for the society. The society frequently also uses the results of the survey to develop live seminars or evening courses in the same subjects.

4. Typical Professional Reference Courses

Figure 1 lists some typical Professional Reference courses along with (where applicable) the professional society for which they were initially developed. Notice the high degree of practicality reflected in the subject titles. For example, in school, an architect learned all about design work. A continuing education course in design would hold very little interest for him. What he didn't learn, and what he needs in his professional world, is how to market his services, or how to analyze a land Development project and how to present that material effectively to prospective investors and lenders.

Figure 2 shows the course content for one of MGI's newest courses "Finance for the Manufacturing Engineer" developed for the Society of Manufacturing Engineers. Note again in the course content listing the emphasis on practicality and applicability -- "how to prepare and accurately control . . . budgets," "making sure overhead costs are allocated fairly" etc.

The authors of MGI's courses are generally pragmatic individuals with actual experience in the subject material about which they're writing. For example, Dr. Herbert F. Spirer, Professor of Industrial Administration at the University of Connecticut is a former manufacturing executive with actual project and financial management experience. He is the author of several of MGI's courses, including "Effective Technical Project Management," "Achieving Results Through Financial Management" and, one of MGI's newer courses developed specifically for the American Society for Quality Control, "Achieving Results with Statistical Methods". The course was written by Dr. Spirer over a two year period under the guidance and review of a select ASQC committee, comprised of five internationally recognized authorities in the quality sciences field, and chaired by Mr. Lee Hathaway, ASQC's Assistant Director of Education and Training.

Mr. Robert B. Darling is the author of two of MGI's courses aimed specifically at the professional practitioner, "Managing a Professional Practice" and "Successful Marketing of Engineering Services." Mr. Darling is a consultant to consultants who helps professional firms of engineers and architects improve their marketing and office management-related activities.

Figure 1

Typical MGI Professional References Courses

Course	Originally Developed For
Achieving Results Through Engineering Management	Institute of Electrical and Electronics Engineers
Managing a Professional Practice	National Society of Professional Engineers
Land Development for Architects	American Institute of Architects
Achieving Results with Statistical Methods	American Society for Quality Control
EDP Game Seminar	Institute of Electrical and Electronics Engineers
Reducing Production Costs Through Efficient Material Handling	American Institute of Industrial Engineers
Marketing Architectural Services	American Institute of Architects
Effective Technical Project Management	Institute of Electrical and Electronic Engineers
Starting Your Own Consulting Business	Institute of Electrical and Electronics Engineers
Finance for the Manufacturing Engineer	Society of Manufacturing Engineers

Figure 2

Course Content

Finance for the Manufacturing Engineer

Section One How to Prepare and Accurately Control Manufacturing, Departmental and Project Budgets.

Section Two Making Sure Overhead Costs are Allocated Fairly.

Section Three How to Value Your Inventory using LIFO, FIFO and Weighted Average.

Section Four How to Present Equipment and Facilities Investment Decisions to Management; Breakeven and Financial Investment Analysis.

Section Five How to Present Equipment and Facilities Investment Decisions to Management; Capital Budgeting.

Section Six How to Use Past History, Industry Indicators and Statistical Sampling to Accurately Forecast the Future.

Section Seven Understanding Financial Statements; The Profit and Loss Statement and the Balance Sheet.

Section Eight How to Determine Depreciation and What it all means.

Section Nine How Professionals Evaluate a Company's Financial Health: Analyzing Financial Ratios.

5. Course Pricing and Marketing

MGI's courses are divided into single-unit, two-unit and three-unit programs, the number of units referring to the number of loose-leaf binders which make up the complete course. A single-unit course is priced at $85 to $100, two-unit at $125 to $150 and our only three-unit course, "Achieving Results with Statistical Methods" is priced at $195. These are prices for the U.S. and Canada. In other countries, because of the requirement for Air Mail of all course material and exercises, the prices are increased by $15 U.S. per unit. Not only are these prices considerably lower than the cost of a comparable live seminar, but also they require neither travel nor time away from the office. In addition, as a Professional Reference Program, the course material is always available to the student, and MGI is always ready to process the students' exercises, whenever they send them in.

Just as the students receive feedback on their Skill Development Exercises, MGI in turn automatically receives feedback on the quality of the course material. If students consistently have difficulty with a particular exercise, then we know that either the exercise is too difficult, or that the associated course material is not sufficiently clear. In any case, we then take steps to make the necessary improvement in future editions of the course.

Because MGI's courses are sponsored by professional societies for their memberships, we are deeply concerned that the registrant in an MGI course receives what he expected when he enrolled. To that end, we take several key steps:

First, we offer all our courses to prospective registrants on a no advance payment basis. The student simply sends in an enrollment card and we send him the course material. As we indicate specifically in our promotional material, "if for any reason you're not completely satisfied with the material, you may return it within 15 days unused -- no cost, no obligation, no questions." In reality, of course, that 15 day period sometimes stretches to several months. We'd rather have a course sent back late than receive payment from a dissatisfied student.

Second, we send out questionnaires to a random sampling of all our course enrollees each month. The questionnaires specifically ask the student to indicate his degree of satisfaction with the course material in general, his degree of satisfaction with the content level and his degree of agreement that the promotional material accurately described the course he received, all rated on a scale of 0 to 10. Space for additional student comments is also provided.

Third, every student who completes an MGI course receives, along with the Completion Certificate, a questionnaire asking for his comments about the value of the course, its effectiveness and its quality, again on suitable rating scales.

6. Enrollments

MGI currently enrolls approximately 6,000 students a year in its various courses. Based on a 1976 demographic survey of an MGI student sample, their average salary level is $24,000, their average age 39 years and their level of responsibility ranges from Project Engineer to top corporate executives and principals of architectural and consulting firms.

As evidence that our courses really work, I'd like to cite a letter from J. Anderson Plumer, President of Lightning Technologies, Incorporated, a firm which he started in the Fall of 1977. Mr. Plumer, a student in MGI's Professional Reference Program, "Starting Your Own Consulting Business" wrote to MGI, "The sections of your course which I completed last Spring were most helpful, particularly in preparing my proposal to the bank. For example, I used the objectives prepared in Section 1, the budget in Section 2, and letter to potential clients in Section 3 in my proposal to the bank, which resulted in a funding commitment. After slight revision, I used the letter again to announce the formation of my firm to potential clients."

Not all our courses are quite as on target as that one was for Mr. Plumer, but it is certainly the objective for which we continually strive.

7. Conclusion

MGI's short and long range objectives are quite similar. It is our basic objective to provide continuing education for the professional, current up-to-date topics for up-to-date engineers, architects, scientists and physicians. The half life of an engineering education has been estimated to be as low as five years. We want to make sure that the engineer and every other professional has access to current continuing education, so that 10 years, and 20 years, and 30 years into his career he is not considered an obsolete engineer with an out-dated education, but rather is considered a currently knowledgeable engineer, with a great deal of experience.

HENRY N. OPPENHEIMER

Mr. Oppenheimer is President of The MGI Management Institute, a firm which he founded in 1968 and which provides continuing education correspondence courses in management and technical areas for engineers, architects and other professionals. He is the developer of the Management Games Seminar, a correspondence course in which the student manages a simulated firm against competition, and has written other courses in financial management and the behavioral sciences. Mr. Oppenheimer received a BEE degree from City College of New York in 1954, an MSEE from Columbia in 1958, and an MBA from the University of Connecticut in 1970. He is currently writing his dissertation for a Doctorate in Management from Pace University.

A LEARNING MODEL FOR UPDATING OLDER TECHNICAL AND PROFESSONAL PERSONS

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Summary

One of the more serious problems facing older technical and professional persons is their ability to maintain their motivation and current knowledge base. This paper deals with the updating process of older professional and technical workers. The updating process is conceived here as involving two major aspects: motivation and work environment. Motivation will be discussed primarily through the expectancy theory. The work environment will be presented as consisting of aspects of variables which include organizational climate, the job itself, subordinate-superior relationships, peer interaction and management policy. An updating empirical model will be presented. Implications of this model will be discussed in terms of maintaining competence in the older professional especially at mid-career and how this relates to work productivity.

During the working years of a technical and professional person, roughly between the ages of 25 and 65, a critical issue is whether he or she can maintain a high level of competence against the eroding effect of the passage of time. Technical and professional persons are especially threatened by the potentiality of becoming outdated in their skills and their knowledge. It is not enough for workers in these fields to maintain the competence acquired in the years of formal education. Their information bank is anything but static; the norm is perpetual change. Psychologists, scientists and engineers have no choice but to plan for a life of continuous self-education and self-renewal by keeping abreast of new developments and new knowledge which are constantly being generated by research.

Keeping current with new developments in science and technology is what we refer to as updating. The reverse of updating is obsolescence. In this paper I propose to describe an empirical model for keeping older technical and professional persons updated.

Updating is a learning process. Learning is basically change. Learning is a complex growth process facilitated by numerous factors, among which the most important are motivation, meaningfulness, reinforcement, generalization, participation, coaching, experience and feedback of results. Updating is a dependent variable resulting from a combination of psychological and work environment conditions. In the updating model presented below, motivation is the chief psychological component. But an individual's motivation is strongly influenced by his work environment. In the context of our model, work environment is the second component and consists of five parts: organizational climate, the work itself, managerial-subordinate relationships, colleague interaction and management policy. It is assumed, therefore, that all these factors in the work environment will have some impact on the learning process which is updating either independently or in combination.[1,2,3]

Definition of Keeping Up-To-Date

When we speak of keeping up-to-date in one's profession we refer to such behaviors as making use of current concepts, practices, theories and points of view in both one's field and allied fields which bear on the work of one's organization. Keeping up-to-date also means being familiar with what others in the same field are working on, what problems they are trying to solve, what approaches to solutions they are taking (NSF, 1969).[4] We can therefore describe the updated professional as showing the following behaviors: keeps current with advanced technology and knowledge in his field; effectively organizes and applies his knowledge in the performance of his work; is current in recent developments outside his special field; uses all available sources of information in reaching decisions; provides information that is accurate and reliable; contributes ideas relating to activities outside his immediate responsibility; demonstrates ingenuity in solving problems and seeks methods and means of continuously improving his proficiency.[5]

As indicated above, updating is assumed to consist of two major components: motivation and work environment. Figure 1 presents an empirical formula showing the multiplicative aspects of the updating process. The model views the professional as existing in a system whose components influence him to keep up-to-date.[1]

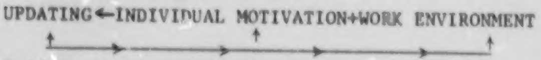
FIGURE 1
The Updating Model

$P(U) = f\ (M.W.E.)$

$P(U)$ = Probability of Updating
M = Individual Motivation
W.E. = Work Environment

$W.E. = W_1(O.C.)+W_2(J.C.)+W_3(S.S.)+W_4(C.I.)+W_5(M.P.)$

$W_{1---}W_5$ = Weight Assigned to Each Variable
O.C. = Organizational Climate
J.C. = Job Characteristics
S.S. = Supervisor-Subordinate Relationships
C.I. = Colleague Interactions
M.P. = Management Policy



Self-Motivation for Updating

Most technical and professional persons, especially those engaged in R&D work, are aware that keeping current with new technology and information is essential for maintaining professional competence. Only a minority of highly-trained professionals hold the opinion that the idea of rapid obsolescence in scientific and technological skills and knowledge is being overplayed. Recognition that there is a problem--that knowledge is a perishable commodity--is the first step in the direction of updating.

The individual's motivation to update is a corollary to his motivation to perform well. Generally speaking, the same motivators which spur him to improve his performance are those which motivate him to update. Some of the behaviors which are recognized as motivators are: interest and curiosity, achievement need, advancement, challenge, recognition, autonomy, and responsibility. These can be classified as intrinsic or self-motivators arising from the individual's personality and personal needs, as distinguished from extrinsic or external motivators which arise from outside the individual, or, in this case, from the work environment. Motivational factors arising from the work environment will be considered later.

It should be pointed out that while motivation is undoubtedly an important variable in updating behavior, only a few motivation studies have been made to date which relate directly to updating per se.

The close parallel between the motivation to perform well and the motivation to update is evident in responses by scientists and engineers themselves in answer to the question: What motivates you in your work?[6]

The most frequent answer is: a challenging problem. Why? "Because the problem arouses curiosity and interest. It has not been solved. Little information is readily available about it. It requires an innovative solution." Also it is on the leading edge of knowledge. It can lead to new technological output. It means freedom to explore and carry out my own ideas and initiative.[5]

Shearer and Steger investigated six dimensions of motivation in relation to keeping-up-to-date. Five of the six hypotheses were confirmed:[7] 1) the higher the career expectations, the less obsolescent the person; 2) individuals who perceive a duty to stay current spend more off-work time in updating activities in their field; 3) people with a future time orientation spend relatively more time after work keeping up-to-date; 4) high achievement need influences behavior to prevent or retard obsolescence; and 5) people with strong beliefs that they control their future have an orientation which tends to prevent obsolescence.

The Expectancy Theory of Motivation

The expectancy theory of motivation postulates that motivation consists of a complex combination of individual judgements concerning the accomplishment of job goals and the immediate rewards or outcomes gained from these goal accomplishments. It has practical application to the updating process. Applied to work motivation, it conceptualizes man as one who chooses to behave in a way which maximizes his chances of acquiring future desired rewards. Also it provides a theoretical structure to describe any cognitively controlled behavior--within any set of individuals--not just professionals. The most important characteristic of expectancy theory is its flexibility, the result of its process nature.

Using expectancy theory Porter presented a number of provocative hypotheses that require testing: it must be clearly demonstrated to the employee that his effort will lead to effective updating performance; subgoals for updating should be set which are obtainable and identifiable for the individual; organizational emphasis should show that updating is an important activity; the reward value of updating behavior should be enhanced by tying it to other more obvious organizational rewards such as promotion and salary.[8]

McIntyre relates how expectancy theory can be applied to updating in three ways.[9] First, the theory dictates that an individual's goals should be elicited from the person himself. The same set of goals should never be assumed to be had by all. If management discovers that a professional is not aware of certain potential goals of the organization, it can intervene and make the goals known to him. Second, the organization must determine the importance....of a set of goals by probing at the level of the individual professional. Once again the organization may intervene to try to influence an individual's valence or expectancy of a particular goal. Third, because it is a process theory, it allows the organization to be flexible in its outlook towards its professionals. There is no need to establish a specified set of goals and outcomes for all. At the same time, the theory does not invalidate the existence of a set of common goals. Finally, the organization can use expectancy theory as a tool with which to diagnose the individual's obsolescence.

Arvey and Noll utilized expectancy theory to identify motivations in older engineers.[10] They found that the three most valued outcomes out of the eleven measured were: making use of abilities, accomplishments, and secure employment. The three least desirable were: receiving praise, supervising others, and advancement. Salary ranked sixth in importance. These findings identify job outcomes that can potentially turn on older engineers. Similarly Goodman, Rose and Furcon showed that the expectancy model was a more useful predictor of motivational determinants of scientific performance than the motivational measures used by Pelz and Andrews.[11]

Goal Setting

Keeping up-to-date can be stimulated through goal setting activities. Management by objectives is a mutual goal-setting method used between managers and subordinates. The technique aims to elicit commitment and effort. Locke has demonstrated that individuals who set hard goals will produce at higher levels of performance than individuals who set easy goals; and that individuals who set specific goals produce at higher levels than individuals who do not set goals or who are told to do "their best."[12] In performance appraisal situations, the process of sitting down and formulating mutually agreed upon performances and explicit updating goals may increase effort to accomplish the goal of keeping up-to-date.

The MBO program utilizes expectancy theory in combination with goal setting. The very act of setting goals between the manager and his subordinate has built into it the possibility of intrinsic rewards, especially when the goal is met. These two conditions can yield a high effort reward probability for increasing motivation and learning on the job.

Work Environment

The work environment for most professionals is an organization. The climate of the organization in which an individual works can be a positive motivator for updating or it can be a demotivator which ultimately produces obsolete workers. A recent NSF report supports the concept of the work environment described in this paper.[13] "A significant new insight relative to the maintenance of professional vitality concerns the importance of the work environment. Important elements of the work environment include job design, supervision, colleague interaction, and reward systems. A job that is challenging stimulates vitality and encourages learning that occurs naturally by doing the job. Conversely, dull jobs can have the opposite effect. Leadership provided by managers is one of the most important influences on the behavior of professionals and therefore has a significant impact on individual performance and productivity. Opportunities for peers to interact also promote learning with the opposite effect occurring from isolation. Similarly, reward systems in organizations can either encourage or discourage learning and the maintenance of professional vitality."

Organizational Climate

Pritchard and Karasick redefined organizational climate based on a number of previous definitions. Organizational climate is a relatively enduring quality of an organization's internal environment distinguishing it from other organizations: (a) which results from the behavior and policies of members or organizations, especially top management; (b) which is perceived by members of the organization; (c) which serves as a basis for interpreting the situation; and (d) acts as a source of pressure for directing activity.[14]

Updating behavior by professionals is strongly influenced by the organizational climate in which they work. Organizational and management practices affect motivation, condition attitudes, and shape the behavior of members of the organization.[15] Campbell and Dunnette have identified a high organizational climate as having some of the following characteristics: (a) achievement--a desire of the group to do a good job and contribute to the performance of the company; (b) concern for excellence--degree to which the group is concerned with improving individual performance, being flexible, innovative and competent; (c) problem-solving emphasis--extent to which the group anticipates and solves problems related to group functioning; (d) reputation--organization reflects status and reputation of individual's work group as compared with other work groups; (e) training opportunities--degree to which the organization provides training for individuals; (f) atmosphere--degree to which supervisors generate a supportive and friendly atmosphere; and (g) initial job orientation--individuals are informed of what to expect when they first start on the job.[16]

Organizational climate is a major factor in maintaining the technical vitality of professional workers. Corporate policies and practices as implemented by management create the working environment. The environment can stimulate growth, innovation, and updated professionals, or it can stunt growth and stifle creative effort so that men work at less than their full potential. A vital organizational climate is characterized by high productivity, sense of purpose among its employees, sense of personal opportunity, feeling of accomplishment and excitement. The climate that offers the potential for recognition and reward, openness to change to new ideas, strong contact with new developments, and outside the organization is one which fosters updating.[5]

Management Policy in Updating

A company should have a written policy statement that requires updating for its employees. An example of such a policy statement is that of the Sandia Laboratories. Many companies have educational assistance funds that reimburse employees who complete education courses, but few companies make continuous updating mandatory. In our study of engineers, 79% reported that their companies had educational assistance programs, but three fourths of the engineers reported that this availability had no effect in motivating them to undertake additional course work.[17] Similarly, in a study of natural resource managers and scientists, 52% indicated that existence of a policy on educational assistance did not motivate to undertake further education.[18] Yet 83% of the same group considered keeping up-to-date important and 80% said that their job performance and job competence increased as a result of participation in continuing education. Only 50% of the natural resource managers and scientists felt that the organization rewarded them for their participation in continuing education. The main reasons given for lack of participation in further education are lack of time, pressures of family and the job, and the fact that the job does not demand more education.[17,18]

W. E. Wilson, a vice president at General Motors, warned that engineers who ignore the meaning of technical obsolescence become technically obsolete, because then they approach problems with outdated viewpoints, theories and techniques.[19] While he stressed that the individual must be basically responsible for his own development and updating, he pointed out that the employer has an equal responsibility to provide the work environment and incentive to encourage the engineer that there is a premium on up-to-date education. If technical obsolescence is to be minimized then the organization's commitment to the management of change and development of people must have top management approval and implementation.

W. Anders, Texas Instrument personnel man, states his company policy: "The company has specific corporate goals and objectives that it must meet. One of these objectives is to create a working environment where all individuals are motivated to participate in the achievement of company goals through the pursuit of their personal goals to the maximum possible extent".[20]

The NSF report concludes its study of organizational policies and practices by noting: "The three key points in top laboratory management philosophy of continuing education are: management accepts the responsibility to provide at least some opportunities for scientists and engineers in the R&D work force; management expects R&D employees to keep themselves up-to-date, particularly in their own fields of specialization; and, finally, management accepts only limited responsibility for motivating the individual. Managements which provide opportunities for continuing education believe that those who do not take advantage of them are not worth attempting to salvage. The initiative is left to the individual."[4]

Thompson and Dalton have formulated a career-stage model in an R&D organization that helps explain the difference between high and low performers at different age levels.[21] Close analysis reveals that the more effective organizations have policies and practices more consistent with the concept of career stages. They identified a number of management policies that have interfered with the updating process and contributed to obsolescence. These are: devaluation of the technical contribution of the engineer; management structure that overemphasize product planning; cost systems that work against career development; and inadequate manpower planning.

Technical Vitality

Miller's vitality concept is an experiment in management policy to reward updating. It has as one of its objectives the redesign of the working environment, the work and rewards to improve the of scientists and engineers.[22] Its intent is to improve the capacity of the environment to provide learning and growth opportunities and appropriate rewards for growth. These activities enhance updating and minimize obsolescence. Similarly, Anderson's efforts at IBM to put new life into R&D is directed to the redesign of the organization climate dimension.[23]

Miller uses the term technical vitality as a shorthand way of describing a set of activities designed to help engineers and scientists become more productive. He describes three combined conditions which affect vitality: rapid advances in technology which lead to a form of human obsolescence; slowed personal growth leading to aging in professionals--which raise questions about the decline in productivity and the need for extending it; reassessment of the value and cost of technological progress--this creates questions about motivating engineers and the quality of an engineering education. He believes that technical vitality is the key to future productivity of engineers and scientists.

To accomplish these goals, a number of improvement strategies at both the individual and corporate levels have been initiated at IBM: increase the importance of continued learning and growth; redesign the organizational environment, work, and rewards; improve understanding of productivity; and build self-confidence and understanding.

Miller's program represents some of the most advanced applications of the behavioral sciences to the updating process. It should be watched with great interest by all organizations.

Branscomb describes two key attributes of a vital technical staff member: adventurous and inquiring attitude, and a sense of professional accomplishment.[24] Other indicators of vitality mentioned are: evidence of intellectual competitiveness with peers, professional activity, and publications; self-confidence, as evidenced by vigorous, well prepared defense of ideas; willingness to use good ideas of others; willingness by managers to hire and promote young people who are more able than they are; entrepreneurial in spirit and willingness to take risks as evidenced by courage to bootleg projects to champion unpopular concepts and be willing to do battle with market forecasters for truly new products. A person whose behavior is similar to the ones described above cannot help but keep up-to-date.

Thompson and Dalton conclude that in technology based organizations the most critical factor is the development and maintenance of an up-to-date and motivated work force.[21] They recommend three broad areas in which managers can make improvements and thus avoid an obsolete organization: 1) reward technical contributions by paying for performance, not position, seek inputs in decision making from scientists and engineers, increase the visibility for contributors by giving recognition for accomplishments; 2) reduce barriers to movement by limiting tenure in supervisory positions, revise cost accounting procedures so that senior people are not excluded by accounting procedures from working on projects using new technologies, more effective use of lateral transfers; 3) focus on careers, use matrix organization methods to insure career development, provide semi-annual manpower review to assess career professionals, and career monitoring to insure new assignments every four years.

A Challenging Job--Its Relation to Updating

Margulies and Raia asked research and development scientists and engineers, "What was the most fruitful learning experience you have had over the past year or two?" The most frequent response was on-the-job problem solving (42%). This was described as being assigned to "interesting tasks," "broadening projects," and "writing proposals which force me to dip into the literature and become current on everything connected with the project."[6] When on-the-job activities include challenging assignments, the exploration of new tasks enables scientists and engineers to assess their own knowledge and fill in gaps and deficiencies.

Pelz and Andrews reported some findings about scientists and engineers in their job functions. The more kinds of research and development functions the scientist is engaged in, the better his performance. Maximum performance seems to occur with four to five functions. To stimulate updating and build diversified skills in scientific personnel, Pelz and Andrews recommended: "The next time you need to probe a specialized area, give the job to a man (or a small group) who is working in a related area. Don't give the job to a man who already is a specialist in that area. The man in a related specialty will dig into the field with new zest and excitement. He will develop fresh ideas that experts in the field would overlook."[25]

When engineers were asked to describe various aspects of their job, less than 50% of the engineers agreed with the following statements: my job is technically challenging and broadening; my job makes use of my skills; my job measures up to what I want out of a job; and my job forces me to work up to the limits of my ability.[5] In fact, engineers consistently point out that 50-90% of their work is routine and could be more easily done by a technician. Ritti reported that the lack of opportunity to perform meaningful work is at the root of widespread frustration and dissatisfaction among engineers.[26]

Bray's study of AT&T managers reports a significant finding.[27] A challenging job is of great importance to maintaining managerial motivation and serious effort should be made to expand the scope of the managers job to fit his ability. Jobs which provide challenge, a sense of achievement, responsibility, and accomplishment provide a basis for continuous self development.

Shearer and Steger tested three hypotheses relating the work experience of engineers and managers to obsolescence.[7] All three hypotheses were positive. They found that varied job assignment provided opportunities to use and maintain previously learned skills, and for increasing a person's exposure to new developments and ideas. The second hypothesis stated: the less a person feels he has used his skills, the more obsolescent he is likely to be. Their findings show that the more a person is willing to invest the time and effort to develop new skills, the less likely he is to become obsolescent. The third hypothesis dealt with participation in decision making. Perceived participation in decision making was found to be the best predictor for keeping current and preventing or retarding obsolescence.

Hackman and Lawler have utilized job design as a method of enriching jobs.[28] Job design refers to a deliberate purposeful planning of a job, including any and all of its structural or social aspects. Job enrichments attempts to make the job more challenging and interesting, by adding the following dimensions: skill variety; task significance; task identity; autonomy and feedback.

Susman offers four job enrichment suggestions which can contribute to the reduction of underutilization and misutilization of engineers; the partition of projects into modules of subtasks which represents a psychological whole and a contribution which the engineer can identify with: the use of horizontal rather than vertical decision nodes as a means of introducing greater equality in the decision making process; the authority for the supervisor and his subordinates within each module to make appropriate decisions rather than the project manager who is several levels higher; and allowing engineers to participate in decisions before the final design is approved. Such involvement gives the engineer a larger piece of the action in the organization. His responsibility motivates him to insure that he maintains his competency in his field.[29]

The Supervisor's Role in Updating

The supervisor or technical manager plays a crucial role in the professional development of his subordinates especially in updating, and continuing education. A study by the NSF found three separate styles of supervision in R&D organizations employing scientists and engineers.[4] The study classified the supervisors by the manner and degree to which they stimulate and attempt to motivate their subordinates to engage in continuing education. The "Administrator" is seriously concerned with implementing management policy including policy concerned with continuing education, and tries to arouse the interest of subordinates in whatever employer sponsored activities are provided. The "Innovator" is vividly aware of the potency of new knowledge and of continuing education and regards these activities as central to his supervision of others. The Innovator is alert to opportunities to create continuing education activities in addition to pushing those sponsored by management.

The "Inactive" type of supervisor is basically passive and non-committal in his attitudes.

Prior to the NSF study quoted above, Dubin and Marlow reported that 64% of 2,094 engineers indicated that their supervisors took a non-committal attitude towards their education and development.[17] Corroborating evidence of the Dubin and Marlow findings is found in the NSF study, where almost half of the engineers and approximately one-third of the scientists reported attitudes of non-interest in their professional development by their supervisors.[4] Similarly, 42% of 5,598 natural resource managers and scientists reported that their supervisors were non-committal to their growth and development.[18] Landis in an industrial study of engineers asked, "How does your immediate supervisor feel about further job-directed education and training?"[30] Thirty-seven percent replied, "not encouraging at all"; 4[illegible]%, "somewhat encouraging"; and 16%, "very encouraging." He concluded that it is the immediate supervisor that counts in the development of subordinates, "If the boss does not encourage a man, he will not take further course work."

Far more serious and frequent are the barriers created by supervisory pressures for immediate results. Daily pressures are stressed to the exclusion of any ability to concentrate on what may be required for tomorrow. Competence is defined with respect to the present, not the future, so that little if any support is given to self development efforts beyond the employees presently defined technical specialty. Under these working environments, professional obsolescence is virtually certain. Frequently these supervisory practices reflect organizational reward norms, policies to the contrary. Many organizations base rewards on short term results which seem to imply that personal development efforts should occur before joining or at least not on company time. These findings would suggest that the pressures of the job as exerted by supervisors may hinder the engineer's self development even if the organization has a policy to provide educational updating.

Colleague Interaction and Updating

A stimulating organizational environment which provides opportunities for peers to interact promotes learning, innovation, and the development of ideas. Learning experiences come from interchange with colleagues, discussion with managers and experts, talking with colleagues from other disciplines, or participating on panels and committees.

Colleague interaction is one of the preferred methods of engineer's for gaining needed information. Rosenbloom and Wolek conducted a study on the flow of technical information in engineering and scientific groups in industrial laboratories.[31] They studied technology transfer--how new knowledge that originates in one place gets communicated and used in another place. They found that most information that engineers in industrial laboratories acquire comes to them by word of mouth from colleagues and local sources.

In the acquisition and transfer of knowledge, Rosenbloom and Wolek further report two different modes; the use of interpersonal relationships between knowledgeable persons and the use of professional literature. Engineers rely heavily on interpersonal communication with people in other parts of their own corporation. Scientists tend to communicate with individuals employed outside their own corporation. When using documents engineers tend to consult reports in trade publications, while scientists make greater use of professional literature and written sources of information.

Colleagues are important sources of information. Co-workers are sources for answers to emergency questions. Face to face discussions are considered by engineers to be more productive and speedier than searches of the literature. Colleagues trade information, questions and answers freely. They teach each other, exchange tips and suggest warnings about pitfalls which may be encountered on certain kinds of assignments.

Engineers and scientists look to their colleagues within their working unit for approval and recognition for a job well done, especially if this recognition is not forthcoming from the immediate supervisor or higher management. They are motivated by the desire for approval of their peers.

More than 75% of engineers responded affirmatively to each of the following questions. They agree that: engineers have the opportunity to discuss technical and other problems with colleagues on the job; colleagues on the job help to identify pertinent sources of information; colleagues assist the engineer in approaching and understanding a problem better; colleagues provide the engineer with information on what approaches have been tried by others and what results have been obtained; and colleagues can help an engineer to confirm the best approach and improve his ability to decide on a problem.[5]

Pelz and Andrews found a positive relationship between colleague contacts and performance even when differences in experience, supervisory status, are taken into account.[25] How can colleagues enhance performance? "One way is by providing new ideas--jostling a man of his old ways of thinking about things. But colleagues may do much more. Sometimes a colleague may know something another man needs to know." In short, contacts with colleagues provide intellectual stimulation, new ideas, a lot of error catching coordination, and even some needed relaxation. These are the kinds of activities that foster updating.

Schwartz, Goldhar, and Gambino report that some interesting ideas regarding the nature, source and flow of important information used by innovators in the chemical industry.[32] A large number stated that the open literature was their most important source of information. Yet a surprising 80% got their important information by listening, not reading; and a third reported that the key information was readily available in the industry. Second, internal sources are much more fruitful than external. Finally, informal communications channels are three times more commonly used than formal ones.

The updating process is complex but it is mandatory. It requires the combined forces of individual motivation and organizational support. The common goal is to preserve and promote one of our most valuable resources--the talents of highly qualified engineers and scientists.

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Dr. Dubin's areas of specialization are: professional obsolescence, updating, and work motivation. His recently published model on updating stresses keeping up-to-date as a multidimensional dynamic process which includes both individual motivation and work environment components (organization's climate, the kind of job one has; the role of the supervisor; colleague interaction; and management's policy). His book on Professional Obsolescence resulted from a NATO grant. He organized and conducted a conference on Maintaining Technical and Professional Competence of the Older Engineer for the Engineering Foundation of New York City. This report was published by A.S.E.E. He has contributed a chapter on the Updating Process to the National Science Foundation report, Continuing Education in Science and Engineering, 1977 (SE-78-5). He served as a management consultant in Iran, has lectured extensively in Europe, Asia, India, and Africa for the U.S. Department of State and U.S.I.A. He has more than seventy technical and professional publications.

CONTINUING ENGINEERING EDUCATION
— A NEW ZEALAND VIEWPOINT

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Summary

The development of New Zealand has placed great demands on engineering skills, and has resulted in a comprehensive technical education system at professional, technician and trade level. Rapid advances in technology have shown the need for additional education and training. The New Zealand Institution of Engineers is reviewing the present unstructured system of continuing education and developing a more formalised and structured credit system. The paper describes the background to New Zealand engineering education, and looks at where it is going.

Background

New Zealand is in the south-west section of the Pacific, an ocean which stretches across one-third of the earth's surface. To the west, beyond the Tasman Sea, is Australia, 1,600 kilometres away. From its position on the rim of the Pacific basin, New Zealand is a little over 10,000 kilometres away from San Francisco and Panama, and a similar distance from Tokyo and Singapore. In area 26.9 million hectares, it is similar in size to the British Isles and Japan.

By world standards New Zealand has had a very short history of development. Whereas the first Maori, Kupe, landed in New Zealand just over a thousand years ago, substantial settlement by Europeans did not take place until 1840. Only since 1870 has there been a measurable pattern of general growth and development.

With its small population of three million New Zealand has traditionally relied on the centralisation of much of its development activities, and this has been the case with the provision of engineering services. The principal engineering agency is the Ministry of Works and Development with whose management the author has been associated for the last nine years. In recent years there has grown up a substantial body of engineering expertise outside of the government area. As a result, a good working partnership has built up between the government and private engineering resources in the role of developing New Zealand. There are approximately 4,000 persons holding practising certificates as qualified professional engineers, of whom 500 are employed by the Ministry of Works and Development.

Since 1924, when the Engineers Registration Act was passed, it has been necessary for an engineer to be registered and in possession of an annual practising certificate in order for him to undertake responsible engineering works greater than $80,000 in value (present day figures). To qualify for registration an engineer must pass a system of examinations and a professional interview, and the requirements in respect of these are basically the same as those laid down for corporate membership of the New Zealand Institution of Engineers.

The New Zealand Institution of Engineers is the professional body concerned with the advancement of the science and practice of engineering, and with the profession's changing educational and training needs.

The following is the current statement of the Institution's policy on engineering education for corporate membership:-

1. The required level of academic achievement is that of an approved first degree in engineering.
2. Academic qualification in all branches of engineering by means of a university degree is preferred.
3. When required, additional facilities for professional engineering education in New Zealand should be provided at the universities.
4. There should be provision for students of proven ability in

technician courses to proceed to professional level by way of university education.

5. The Institution examination system should remain an acceptable mode of entry into the profession.

The Growing Need for Continuing Education

In recent years, several major changes have had an influence on the profession and on its education and training system. First, there has been a rapid diversification of the engineering discipline. Whereas during the earlier post-war years civil engineering was the major discipline, the present fast-growing areas are production and chemical engineering, heavy and light electrical and electronics, building services and public health engineering.

One of the problems arising out of these new demands is the fact that the lead-time for educating and training qualified professional engineers (about seven years) is often much greater than the time associated with shifts in society's demands on engineering. As a result, there has been a tendency to generate redundancies in some areas and shortages in others. This has called for more flexibility in the system of educating, training and re-training within and between disciplines.

The second problem facing today's engineer is the need to understand much more about things other than engineering in its technical sense. Community attitudes are changing, not only in the definition of engineering requirements of social objectives, but also in the definition of who are the experts. No longer does the general public accept an engineer's findings without question. There is no automatic authority due to professionalism.

Third, there has been a substantial revolution in technical education itself. The erstwhile rapid growth of university education has now been superseded by that of tertiary technical institutions producing a wide range of qualifications at sub-professional level with bridges to the university system on a merit basis. Thus a substantial infrastructure of technicians and support personnel is developing, and there is some evidence that industry and the professions are not yet fully equipped in the management skills to deploy this new resource effectively.

For some years it has been evident that a more positive system of continuing education should be set up. Such education has been almost entirely provided by the centres for continuing education of the universities. In most cases courses have been planned and given by staff of the two engineering schools and occasionally by members of the profession in practice. The courses have been valuable, but because of their irregular nature they have not covered the field adequately nor have the right people always been able to attend.

In 1975 the Education Committee of the New Zealand Institution of Engineers set up a sub-committee based in Auckland under the chairmanship of Dr G R Martin then on the staff of the Auckland School of Engineering. The committee was drawn from a wide range of interests including central government, local authorities, universities and technical institutes, and private organisations.

The Report of the Auckland Sub-Committee on Continuing Education

In its deliberations, the sub-committee placed major emphasis on the following questions:-

1. What were the major deficiencies in the existing system?
2. Should the Institution have an administrative role (including planning and co-ordination) in any improved system?
3. Should a more formal structured system be established (apart from existing graduate degrees and diplomas)?
4. Should such a structured system be associated with a recognised form of credit?

When the sub-committee examined the existing system of courses and seminars offered principally by the universities, the following deficiencies were evident:-

1. Topics for courses and seminars depended to a large extent on the enthusiasm and particular interests of university staff and co-opted members of the profession. As a result the needs of the profession were being met from time to time in some areas only.
2. Courses and seminars were offered only in three main centres. This threw an additional burden on "out

of town" engineers. Those courses which were given in instalments over a period of several weeks posed similar geographical restrictions.

3. Although some courses were being duplicated at two or more centres, in most cases the "one off" system did not make the best use of the time and effort put into course preparation.

4. The problem of employee/employer responsibility was often difficult to resolve for cases where courses were given during the day. Many organisations were understaffed, and staff could not be spared.

The committee then examined the case for a structured credit system. It was already widely recognised that there was a need for continuing education, updating, and professional development following university graduation. It was also generally acknowledged that the existing system with its random approach left much to be desired.

One solution would have been to expand the system in its existing form. For example, assuming the problem of resources could be overcome, a greater variety of courses could be offered and co-ordinated in an improved manner. Greater emphasis could also be placed on the development of taped and correspondence courses to overcome geographical problems. These would be useful steps, but not sufficient in themselves, and the committee felt that more would be gained if a degree of structure and a form of credit were introduced.

The major advantages of a structured credit system were seen as follows:-

1. From the point of view of the employer, the ultimate benefits of a coherent structured system would be more readily apparent. Information obtained from a structured series of courses was more likely to be successfully used. A formal structure also allowed appropriate planning and budgeting for employee's time off.

2. From the point of view of the employee, a structured credit system would encourage greater incentive to participate and provide a means of formal recognition, although recognition associated with a credit system must be seen to enhance promotion prospects. Also recognition by the employer was seen as most important in improving prospects for obtaining time off.

3. Many engineers needed a target to aim for to provide the necessary incentive. A final award associated with a structured credit system provided a logical end point.

4. A structured system with a recognized end point was more likely to provide a positive means of attracting greater formal support from the universities and technical institutes.

5. Some danger was seen in associating credit with individual courses not forming part of a coherent system. The employer's judgement was based on "in job performance", and credits collected from a series of unrelated courses by a "professional course doer" could possibly be of no practical value hence placing the credit system in disrepute.

The System as Adopted

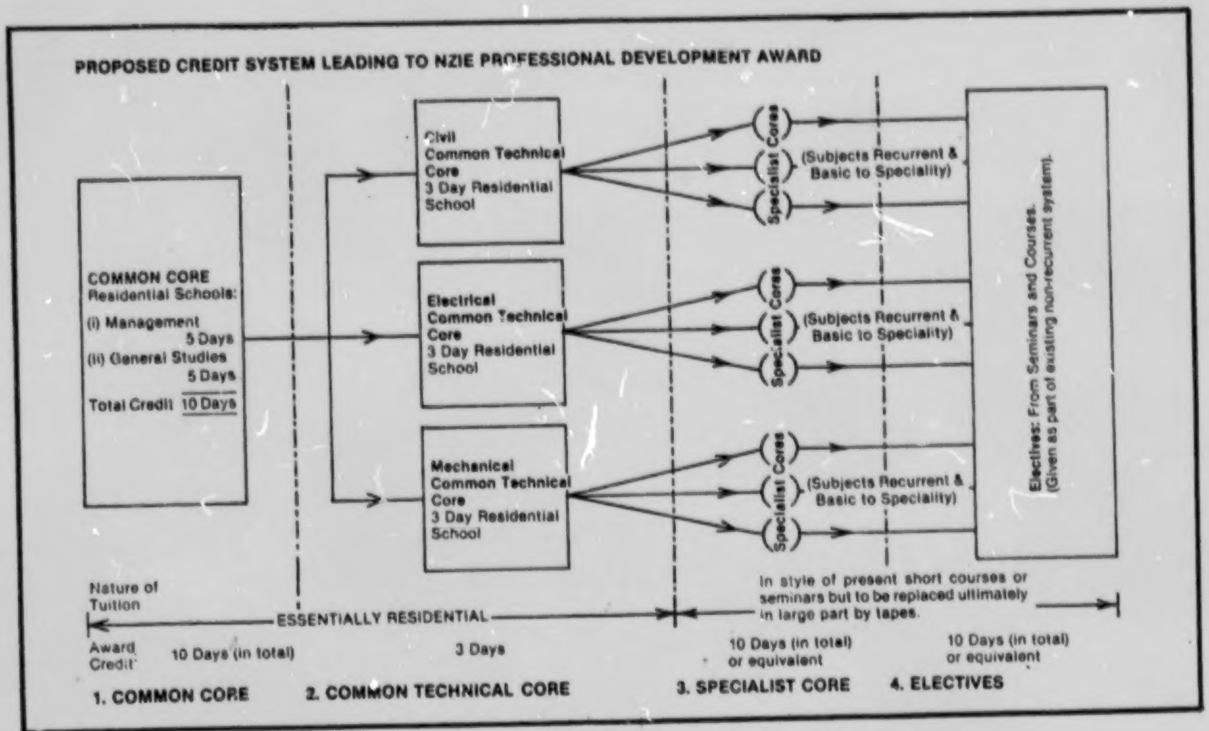
In developing the concept outlined below, the following points were kept in mind.

1. To be successful, the system would have to attract a reasonable number of people and hence be aimed at a mass market. With this in view, the system is developed around major streams of the three principal professional divisions, Civil, Electrical and Mechanical.

2. To be effective, it was suggested that the system should be aimed at a particular age group. The age group from the late twenties to say the late thirties seemed appropriate. At this stage several years post-registration experience has been obtained, and the desire to update knowledge and gain a broader perspective of management oriented topics is probably at its peak.

3. With respect to duration, it was felt essential that a realistic end point to the system be evident - otherwise courses could drag on with a resulting loss of incentive. A structured credit system would help set objectives and enable a reasonable completion time to be achieved.

The components of the structured credit system are depicted in the following diagram.


PROPOSED CREDIT SYSTEM LEADING TO NZIE PROFESSIONAL DEVELOPMENT AWARD
COMMON CORE
Residential Schools:
(i) Management 5 Days
(ii) General Studies 5 Days
Total Credit 10 Days
Civil Common Technical Core 3 Day Residential School
Electrical Common Technical Core 3 Day Residential School
Mechanical Common Technical Core 3 Day Residential School
Specialist Cores
(Subjects Recurrent & Basic to Speciality)
Electives: From Seminars and Courses. (Given as part of existing non-recurrent system).
Nature of Tuition
ESSENTIALLY RESIDENTIAL
In style of present short courses or seminars but to be replaced ultimately in large part by tapes.
Award Credit
10 Days (in total)
3 Days
10 Days (in total) or equivalent
10 Days (in total) or equivalent
1. COMMON CORE
2. COMMON TECHNICAL CORE
3. SPECIALIST CORE
4. ELECTIVES

Common Core

This consists of two courses, one dealing with management topics and one with general studies. Ultimately it is planned to have these as 5-day residential courses. There is a fair weight of opinion in the profession that such residential courses would provide opportunity for informal discussion, formal debate, general feed-back on technical and society-oriented problems, and concentrated study generally. The proposal is to hold the courses at Wellington and Auckland, alternating annually. So far the courses have been non-residential as the market was still being tested and the patronage was expected to be mainly local. Both courses, especially the management one, have so far attracted good attendances and have been well received.

The common core subjects are presently as follows:

Management Topics

Management theory and techniques
Behaviour in the work place
Human relations; contract law
Industrial relations; commercial law
Public relations; marketing
Balance sheet and accounts
Economics; cost accounting
Company law.

General Studies

Regional and local government
Population growth and control
The world's resources
Resource allocation and conservation
Impact of technology on social patterns and the environment
Environmental law
Public participation.

Common Technical Core

The plan here is to hold three-day residential courses in each of the "main-streams" of civil, electrical and mechanical engineering. The basic objective of each course would be to provide a broadly-based technical core of common interest to all specialist streams. For example, new mathematical or computer techniques could be outlined. The latest equipment and materials technology could be described as appropriate for each of the three professional divisions. One day could possibly be devoted to "state of the art" lectures by invited practising engineers.

A typical list of subjects is given for a recently-held civil engineering course. This was a very successful course and attracted 65 registrants from a wide field:-

Materials: fibre-reinforced concrete, steel
Systems engineering
Fluid mechanics: coastal engineering
Computers: water uses, structural uses
Structural engineering: theory, practice
Geomechanics: soil testing, geology
Transportation engineering
Earthquake engineering
Public Health engineering
Fire engineering
Engineering in the future.

Specialist Core

This section would comprise a series of tailored courses to meet the specific requirements of the various specialist streams. Courses would be similar to the several two-four day state-of-the-art courses given at the present time by University Extension Departments on an irregular basis. However, the courses would be offered regularly, and emphasis would be placed on developing taped or correspondence formats to facilitate greater convenience. Participants in the system would elect to take several of the courses offering, making up the equivalent of say at least 10 days of credit. Some overlap or commonality between courses for the various streams would seem likely.

A typical list of subjects in each of the three disciplines is shown below:-

Civil:

Design

Materials
Earth Structures
Foundations
Structural Mechanics
Structural Design
Hydraulics
Hydrology
Public Health
Transportation

Construction

Surveying
Site Construction Methods
Detailing Procedures
Safety
Contract Law and Documentation
Advanced Management Topics
Financial Control

Operations and Maintenance

Public Utilities
Public Health
Highway and Street Engineering
Cost and Material Control
Plant Operation and Maintenance
Conditions of Employment
Advanced Management Topics.

Electrical:

Power

Prime Movers
Generators
Switchgear
Transmission
Power System Analysis
Instrumentation and Control
Distribution
Utilisation
Transformers

Electronics

Electronic Devices
Amplifiers
Logical Operations
Networks
Digital Systems
Micro processes
Power Electronics

Telecommunications

Information Theory
Digital Communications
Modems
Antennas
Propagation
Microwave Systems
Wave Guides and Transmission Lines.

Mechanical:

Design

Computer Applications
Microfilming Techniques
Metallurgy
Plastics
Bearing Technology

Building Services

Heating and Ventilating
Architectural Developments
New Plant Developments
Building Aerodynamics
Energy Conservation
Pipe Flow

Industrial Engineering

Advanced Work Study
Operations Research
Statistical Analysis
Discounted Cash Flow
Network Analysis
Performance Measurement
Production Planning and Control
Organisation and Management

Operations and Maintenance

Control Systems
Production Technology
Heat Engineering
Fuels
Preventive Maintenance Systems
Noise Levels and Acoustic Design
Vibration Transmission
Electric Drive Developments

In addition, some audio tape courses have been developed and these are proving to be very successful. Sets of six tapes on water control have now been used by nearly 400 people since their introduction two years ago, and further taped programmes in the mechanical discipline show equal promise.

Elective Seminars or Courses

This section of the proposed scheme is planned to take advantage of the existing system of irregularly-offered seminars and courses. In addition, further taped programmes will be developed in this area. The existing system will be encouraged to continue in parallel as it draws on the enthusiasm of the course and seminar originators whether from the universities or the profession. Also it enables specific areas of work to be highlighted as the need or demand arises. As in the case of the specialist core, the equivalent of 10 days credit is suggested.

Some Comments on the System

Development of Taped Courses

Audio taped courses (and as a possible complementary development, video tape courses) are seen as an essential feature of the proposed specialist core courses. They provide equal opportunity for all members of the profession to participate in any formal structured continuing education programme by the simple use of a mailing system. Apart from the geographical coverage, audio tapes (and associated notes) also provide a very convenient and effective means of study. The tapes may be used at a convenient time and replayed as often as desired. The concept of organised group study, which is the recommended means of studying from tapes, provides the means for discussion as tapes are played back, and also the incentive to study a particular course on a regular basis.

In view of the significance of taped courses in relation to the proposals for a formal continuing education scheme, the sub-committee considered it important to initiate pilot courses to enable an evaluation of the problems involved. A close study was made of the extensive use of cassette tapes at the University of New South Wales, and several courses were obtained and evaluated by staff members of the University of Auckland School of Engineering. Staff members who finally agreed to pioneer the new approach were Mr I W Gunn who taped six one-hour lectures on Water Pollution Control, and Dr J D Tedford who was responsible for five one-hour tapes on Industrial Ergonomics.

Both courses were administered and marketed by the University of Auckland Centre for Continuing Education. Mr George Clark, supervisor of Professional Courses for the centre, co-ordinated the study and provided valuable assistance. The resources of the Audio-Visual Centre were called on for the production and editing of master tapes. The master tapes were dubbed off on to cassettes using a high speed dubbing machine which produced five copies simultaneously at 16 times the natural speed.

The courses were first offered in August 1976. Comprehensive notes with many illustrations were also compiled for use in conjunction with the tapes, and provided a permanent source of reference. Individual or Group enrolment was offered. Separate fees were charged for the tapes and accompanying notes which enabled a cost saving for group enrolment. For example, a group of three people require only one set of tapes with three sets of notes. Upon enrolling, notes and tapes were forwarded, and tapes returned to the Centre for subsequent use within 10 weeks following despatch. An information sheet describing the most effective use of taped courses was also forwarded. Provision for liaison with the tape authors was provided by way of questionnaires returnable at the end of the course, the intention being that a discussion tape be prepared collating all questions received within a specified period.

Enrolments for the two courses exceeded all expectations. The Water Pollution Control course attracted 356 participants. The group enrolment concept was widely used, as reflected by the reduced number of tape sets mailed (61) to participants. In the case of the Industrial Ergonomics course which was developed for a more specialized professional group, the corresponding figures were 106 participants and 20 sets of tapes. Enrolments covered most major centres in New Zealand.

A number of teething problems were encountered in the initial stages of course preparation, particularly with makeshift recording facilities and static on tapes due to lack of adequate production quality control. However, these problems were gradually sorted out, and the experience gained will be of value for the preparation of future courses. Evaluation questionnaires returned by participants at the conclusion of the two courses also provided useful suggestions for improvements, particularly in relation to methods of presentation.

Overall, the courses were clearly successful, and met a widespread demand which could have only been partially satisfied if the courses had been offered in the normal way.

University Participation

The success of any system of mid-career training for professional engineers must always rest heavily, although by no means exclusively, upon the contributions of university staff. At both schools of engineering at Auckland and Canterbury, a lecturer's past and current participation in continuing education programmes is certainly taken into account when considering his promotion, but there is no formal university requirement for him to conduct extension courses. The Institution of Engineers is presently having discussions with the university administration to have continuing education accepted as an integral part of the teaching activities of the engineering schools. While there is generally support for this as a principle, departments in both engineering schools are suffering from the effects of a heavy teaching load and inadequate staffing.

Professional Development Award

The present plan is for the issue by the New Zealand Institution of Engineers of an award on completion of a structured programme. Members will require to complete all the following sections of the programme:-

(a) The management core course

(b) The general studies core course

(c) The common technical core course

(d) At least 10 contact days in specialist technical core subjects

(e) At least 10 contact days in elective subjects.

In the case of both (d) and (e) above, at least four courses must have been completed in each section irrespective of the total number of contact hours accrued in these sections. The total credit required is 33 contact days overall.

It is expected that a diligent participant should be able to accumulate sufficient credits for the Award in about four years. This would involve an average 8 to 9 contact days participation each year. It is hoped that eventually much of this will be achieved in the person's own time through taped courses. By involving Saturdays at least in the seminars, the burden is shared to some extent between employer and employee.

Credits for the Award may be gained in any order whatsoever. For example, it is not necessary to pursue the common core course before proceeding to the common technical core course.

Members' opinions are divided about this Award, but most seem to favour it for the reasons for which it was introduced. The Award is purely voluntary at this stage, but sometime in the future the question must arise whether a regular updating along these lines will be a prerequisite to the renewal of an annual practising certificate.

Conclusion

Like computers, the half-life of engineering technology is contracting year by year, and in some branches it is little more than five years. While much of the updating of a professional occurs in the course of his work, the time is long past when this can be accepted as the sole prescription. The present ad hoc system of extension courses has served its purpose, but the demands on engineers call for a more logical system of continuing education.

The planned system of courses, credits and awards is not perfect and no doubt there will be some changes. Nevertheless it shows promise and if given the support it merits, it should be one means by which engineers will be much better equipped to serve their clients in a rapidly changing climate of technology.

Acknowledgements

Thanks are due to Dr G R Martin, formerly of the University of Auckland for his work in developing the system as chairman of the sub-committee.
Mr W H M Blackwell has been appointed co-ordinator for the new programme and to him must go the credit for launching the project and getting it under way.

ROBERT G. NORMAN

Born Wellington, NZ 1923
Educated Universities of Wellington and Canterbury, BE(Hons), M.Sc(Hons)
Served with NZ Army in World War II in Middle East, Italy and Japan
Employed as civil engineer in Ministry of Works, advancing to Chief Designing Engineer in 1964; in 1967 appointed a member of the State Services Commission; in 1969 Assistant Commissioner of Works
Spent 2 years in England 1949-50 on University Travelling Scholarships and 18 months 1956-57 in USA on Harkness Fellowship of the Commonwealth Fund
Winner of Freyssinet and Furkert Awards of NZ Institution of Engineers for original contributions to engineering science
Member of NZ Delegation to UN Conference on Human Environment, Stockholm 1972; Chairman of International Working Group on Environmental Education for Engineers, Paris, 1974

SESSION 6C

GROUP III

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Assistant Professor
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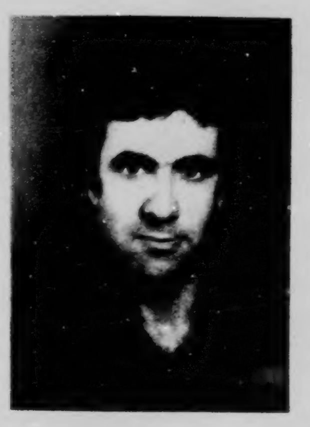
FRIDAY AM

DR. MOHAMMAD MAQUSI



Dr.Maqusi was born in Palestine on August 28,1944.He received the B.S.,M.S.and Sc.D. degrees in Electrical Engineering(Communication specialization),and the M.S.degree in Applied Mathematics,all from new Mexico State University(U.S.A)in 1969, 1971,1973,and 1973 respectively.From 1973 to 1976 he was an Asst.Professor of Electrical Engineering at the University of Mosul (Iraq).Since 1976 he has been with the EE Dept.at the University of Jordan, engaged in developing and teaching EE courses and laboratories.His current research interests include Walsh analysis of linear and nonlinear systems,signal processing,and continuing engineering education.Dr.Maqusi is a member of Jordan Engineers Association, Eta Kappa Nu and IEEE.

A PROGRAM FOR CONTROL EDUCATION AND TRAINING IN LARGE INDUSTRIAL COMPLEXES

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Introduction

Nevertheless the well establishment of the system engineering courses in Egyptian Universities, the gap between supply and demand for automatic control education and training is still growing. Attempts are being done by different professional institutions to overcome such gap. This is done through short programs and summer courses for industrial personnel. The programs are mainly concerned with automatic control and management applications in industry, in addition to the use of computers in industrial processes. This is besides regular postgraduate programs conducted by the different Universities and lead to Diplomas and Master degrees. Such programs require the sacrification of a substantial manhours for education or training, which represents a serious constraint for the industry.

The Egyptian Iron and Steel Complex, started on 1960 with production capacity of 300,000 tons/year and produces now 1,500,000 tons/yearof steel products, represents the main supplier of these products on the national level.[1] The special nature of this complex (more than 24,000 workers and employees and the diversity of manufacturers and maintenance programs [2]) raises the urgent need for an organized regular training and educational programs on both engineering and technical levels.

A new approach has been adopted by the Iron and Steel Co. where a program has been developed to take care of education and training of the technical staff. This program runs in parallel with other programs carried in collaboration with the Universities or other professional institutions which are interested in this problem.

In this paper, the outline and motivation of such programs will be discussed showing the orientation of training and education to cope with the production policy of the plant. Efforts done for supplying and updating information to engineers and technicians will be discussed, with special emphasis on programs which deal with automatic control and instrumentation. Participation in outdoors programs is also considered. Evaluation of results shows the efficiency of such policy.

Difficulties in Continuing Education in Automatic Control.

The importance of training and updating of new technologies, to engineers and technicians, raises the need for providing short courses and training programs on regular terms. This was the motivation for different Universities and Institutions to organize short courses (ranges from two to ten weeks) to overcome such gap. These courses do not offer any academic degree, and are not accompanied with any kind of research work or even providing the student with the necessary tools to carry out investigations for the sake of development and/or solving the problems in their field of work. Also in many cases these courses do not cope with the working conditions of some industrial complexes, where possibilities of having part time bases for the work (to permit personnel enrolment in these courses) are not feasible.

This situation necessitates to approach the problem with a more appropriate plan. Considering its major aspects, the best solution was thought to start with the indoors training taking into consideration working conditions. Such training is mainly organized with the help of the academic and practical experience of the plant sinior engineers and foremen. This does not dispense outdoors training, since both are carried out simultaneously. Here arises the need to coordinate these indoors programs with relevant outdoors programs. Raising funds to supply appropriate educational and training equipments, to run such courses, represents one of the serious problems facing indoors training programs.

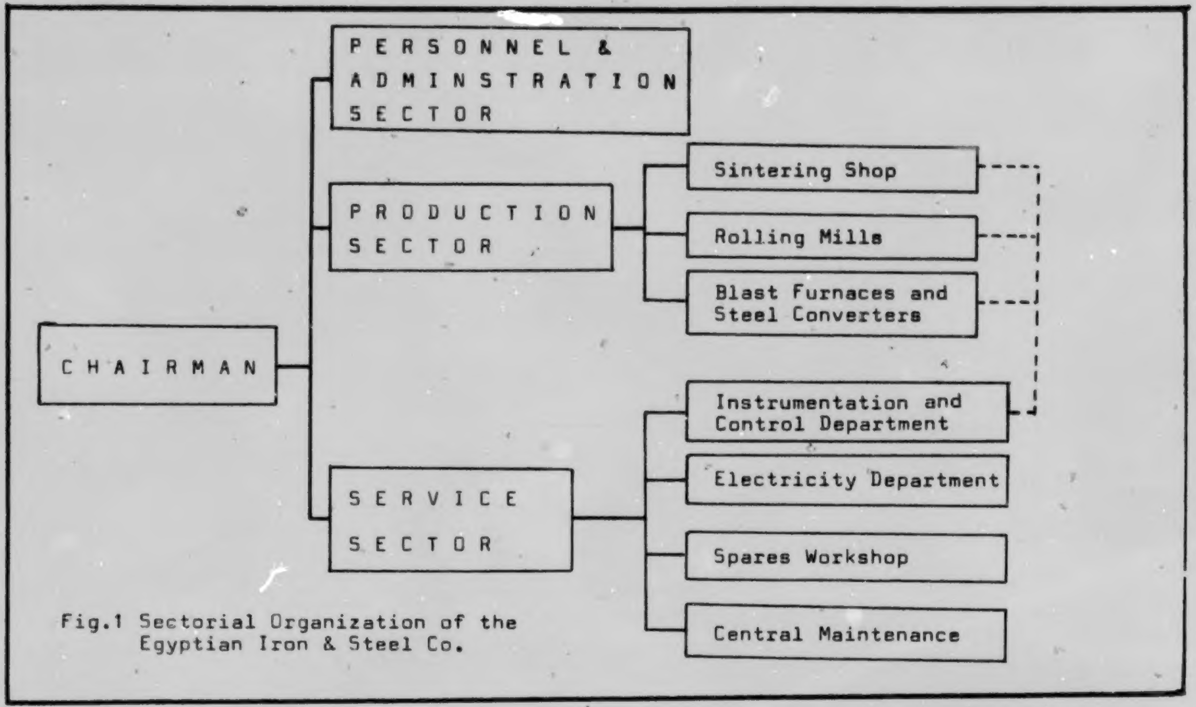

Fig.1 Sectorial Organization of the Egyptian Iron & Steel Co.

Instrumentation & Control Department Role in the Iron & Steel Complex

The duties and relation of the Instrumentation and Control Department w.r.t. the different departments in the plant are represented in Fig.1. This can be summerized as:

1. Erection, calibration and testing of instruments and control components.
2. Rendering rapid service for the stoppages caused by instrumentation or control components.
3. Development of the existing system and unification of the spare parts purchaser.

The sensitivity of the products quality and quantity to the instruments and control systems used makes it important to depend upon a qulified staff in such work.

It was considered early the necessity of continuing the training and education for the personnel of the instrumentation and control department. A thorough study was carried with the collaboration of the EHCAC (Egyptian High Committee of Automatic Control). Such Committee is formed in the late sixties from representitives from the different industrial sectors and the universities. The main objective of the Committee is to establish a link between the industry and universities and research centers to acquint researchers with the real problems in industry and to convince the industry to apply modern techniques. This is done through short courses, seminars, conferences and research projects supervised by the Committee. The study shows the following distribution for participants in the different training and educational programs:

50 % joins indoors programs,

45 % joins EHCAC programs, and

5 % (only graduate engineers) can be sacrified for post-graduate studies.

The diversity of programs delivered in the company and that of the EHCAC was arranged in such a manner that those of the company are leading to the EHCAC courses. The training procedure is shown in Fig.2.

Curriculum Development

Indoors courses for technicians covers the acknowledgment with the different processes carried on the plant, department laboratories and the principals of operation, testing and calibration of the instruments in the department. The duration of such course is 100 hours and is conducted by the senior engineers and technicians in the department.

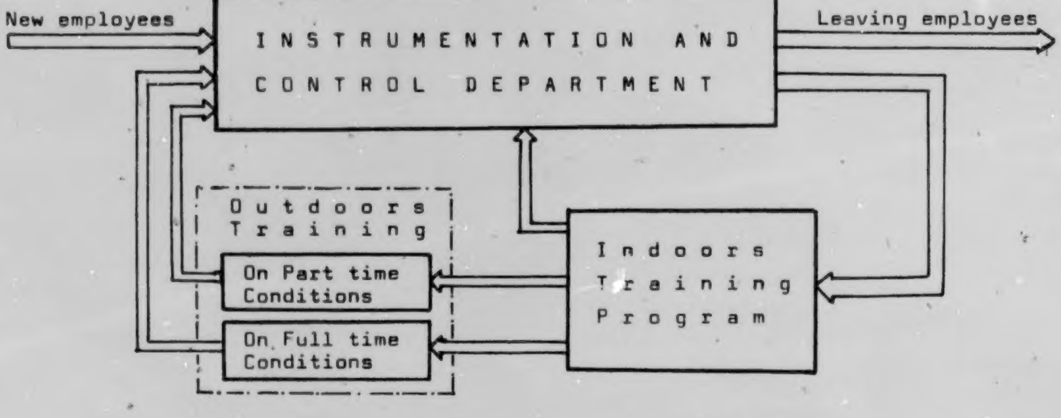

Fig.2 Training Procedure Applied for Engineers and Technicians in Egyptian Iron & Steel Co.

The following courses of the EHCAC for technicians covers the theory of measurements and instruments used in metallurgical processes. Introduction to the Control Theory and different types of controllers are also included. The course is an evening one and managed by the EHCAC lecturers. The duration of the course is 120 hours.

Indoors courses for junior engineers are conducted by senior engineers and EHCAC lecturers. The courses cover, besides the acknowledgment with the plant different production processes, the duties of the engineer w.r.t. erection, testing and maintenance of the plant instruments. In addition, problems of systems used in the plant are discussed to reveal the methodology to be adopted for solving such problems. The duration of such course is 120 hours.

The following courses of the EHCAC for engineers is composed of two successive stages, 140 hours each. Each stage is accompanied by a project dealing with one of the predetermined problems of the company. The time allocated for each project depends on the problem treated, the number of engineers working in such problem and their background. The project is supervised by a university staff member and a senior engineer from the company if possible.

Variances of participants backgrounds represent a difficulty in preparing a fixed module. For example, participants vary from engineers graduated during the 1960's to recent graduates. Thus an outline is stated for the whole program and the contents of each course are slightly adapted to the participants. However, all the programs[3] start with a mathematical base followed by a review for the classical control theory. Then modern control theory is introduced with applications. These applications are usually selected to cope with the participants industries. Typical topics considered are:

First Stage for Engineers

General concepts of control- Linear feedback control theory - Optimal control- Process identification - Adaptive control systems - Introduction to stochastic control.

Second Stage for Engineers

Applied optimization techniques - Distributed parameter systems - Introduction to computers - Industrial applications of computers.

Details of each of the above modules are worked for each group of participants as mentioned before.

Printed documents are prepared and supplied to each participant to serve as a text for such courses. References and text books are supplied through the library of the General Organization for Industrialization. In addition, each factory or department arranges for its own library or documentation center.

Enrollment and Funding

Courses are conducted once or twice a year. Participants are selected from different industries with no restrictions on specialization or graduation date. However, it was noticed that the majority of participants are electrical or mechanical engineers. The class is usually composed from 15 to 20 engineers and is slightly more for the technicians.

Fees are paid by the participants company from funds allocated for training. The majority of the participants have two or three days per week as a study leave during the course period.

Evaluation

Evaluation in the program is based on a final examination at the end of each course. A participant has to pass successfully this examination in order to proceed to the preparation and presentation of his thesis. The thesis is evaluated by the supervisor and an external examiner (either a sinior engineer from the industry or a university professor).

Some of these thesis are selected to be presented (as a case study) in the annual EHCAC national conference on Automatic Control and Systems Engineering. Such conference represents a good environment for fruitful discussions and exchange of ideas between university staff and engineers from different industries.

Some of the participants work can be implemented in their plants. In such case arrangements are made, with the plant staff and authorities, to realize such work in collaboration with the EHCAC. If the implementation of such work needs a financial suuprot which is beyond the available funds allocated for such type of projects, the study will be kept on the reporting level.

In the Appendix, some of the implemented work is mentioned.

Conclusions

Experience and efforts for supplying and updating information to engineers and technicians, in the domain of automatic control and systems engineering, are discussed. The Egyptian Iron and Steel Co. is taken as an example for indoors programs organized by the Instrumentation and Control Department in the company. This will guarantee a permenant satisfactory level of technicians and engineers in performing their jobs.

Outdoors programs are organized with the collaboration of the EHCAC and other professional institutions. These programs offfer a good opportunity for the interaction between the academic staff in different scientific institutions and the sinior staff of the industry.

On the other hand, it is noticed that engineers and technicians of the Instrumentation and Control Department are encouraged by other companies to leave for relatively high salaries (this is due to their outstanding level), even the Iron and Steel Co. puts that factor into account in considering the welfare of the workers.

It is highly appreciated to make some cost/benifit analysis for these programs. This will justify allocation of funds for such activities to overcome major financial problems facing the realization of the implementing parts of the program. In addition it will encourage other companies to initiate similar programs.

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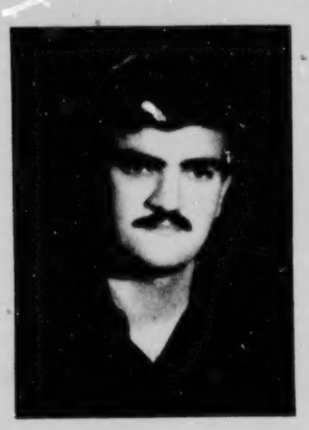
Appendix

Some examples for the technical problems which are solved indoors:

1. Water level control system.
2. Adapting electronic vibrators to substitute mechanical ones.
3. Air recorders and indicators for temprature.
4. Developing electronic weighing scales for Coke conveyor belts.
5. Developing an electronic control system for the measurement of moisture content of Coke in blast furnace.
6. Developing a control system for moisture in a sinter mixture before the sintering machine.
7. Developing an open loop control system in a hot strip mill.
8. Developing a control system for the thikness in a cold rolling mill.



SALAH E. AIDAROUS

Was born on January 12, 1947 in Cairo, Egypt. He recieved the B.S.E.E. degree with honors in June, 1968 and the M.S.E.E. degree in February, 1972, both from Ain Shams University, Cairo. From 1968 to 1972 he was employed as teaching assistant in the Electrical Eng. Dept., A[illegible] Shams Univ. From 1972 to 1976 he joined the Laboratoire d'Automatique et Dynamique des Systemes, Universite Catholique de Louvain, Belgium, where he recieved the PhD degree in Applied Sciences. Since May 1976 he joined the Computer and Control Section, Faculty of Engineering, Ain Shams Univ.

His research interrests include process modelling, optimization and control, Computational techniques in control of Large Scale Systems, application of computers in Systems Engineering, and developing teaching and training programs for continuing education in Systems Engineering for professional engineers.

ENERGY USE AND THE ROLE OF CONTINUING EDUCATION

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0. INTRODUCTION

France needed three years to realize that the energy crisis was a real one! Thence to counteract its effect and to take action for the future, the Government created several working groups to look for a solution to this vital crisis. One of them, created in Jan. 77, received a mandate to advise the Government as to the ways of making engineers aware of the ressources saving problem. The paper will report on the conclusions of this working group and, in particular, develop the one concerning the role of permanent education.

It was, in fact, recognized that no specific education in energy saving could be implemented at undergraduate or graduate levels. The only means would seem to be to orient students'minds towards this aim, during all major lectures. This is a matter for Engineering Schools in which the recent trend to emphasize "the system approach" has already produced good results. This system approach has to be oriented to energy saving by using adequate optimization criteria.

However, there are great hopes that permanent education could meet the need, at least in part, for the following reasons :

a) Permanent education affects engineers who are responsible for development of future systems or better use of present systems.

b) Permanent education is adaptable, with short time constant (less than one year) to the problems of the day,

c) Coordination between lectures given by large centers may result in their being able to offer a complete set of lectures in the main branches of engineers'activities.

1. Background :

France comprising 52 million inhabitants, has no more fossile ressources. She has forests (one third of the common market forests lies in France). The uranium ores rank France in third position. However, due to the limitations of hydraulic ressources the power increase relies upon nuclear power plants only. This is the reason for which fast neutron reactors are so actively developed in this country. Ecology problems tend to slow down the nuclear program, thus the growth rate of the demand.

The role of continuing education was considered by the working group as a positive one because of the large infrastructure which already exists in France in this domain. Continuing Education has a legal status. A law (dated July, 16, 1971) enacts that all firms with more than 10 employees should spend 1% of the total amount of wages paid on continuing education. In fact, for a long time (some fifty years) the Armed Forces have felt this need and, on a small scale, developed their own continuing education through a subsidiary of the Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, a graduate Institute which belongs to the Ministry of Defence. It is worthwhile, however, specifying that this school teaches civilian students. Some 100 engineers are graduated each year; they will be in charge of the design of aircraft and space vehicles or equipment.

The Continuing Education delivered by the above school and the other, named the ENSTA ("Ecole Nationale Supérieure des Techniques Avancées") is managed by the Société des Amis de l'Ecole (SAE) - a non-profit making organization operating in close relationship with the 2 schools and with Industry. Members of the Board belong to the Technical Services of the main Administrations, to Industry (namely Aeronautics, Space, Automobile, Shipbuilding, Nuclear, Oceanology) or are professors at the schools. The Board meets twice a year to review the previous year's lectures and decide on new lectures.

Courses are of short duration : 1 to 3 weeks 6 hours daily. They are very intensive : their goals are :

a) to bring up to-date the knowledge of engineers in their own field

b) to make other techniques available to engineers in order to enable them to assume larger responsibilities.

c) to direct towards another activity executives who feel uncomfortable in their present work.

(*) Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Centre d'Etudes et de Recherches de Toulouse (B.P. 4025, 31055 Toulouse Cedex, France)

Courses are given either in ENSTA (Paris) or ENSAE (Toulouse). The way of teaching is similar to that given at the school, i.e. a course is composed of lectures, exercises, laboratory work, most of the time visit (s) of factories or center(s) and at least one round table. A complete set of documents is issued to allow the participants to refer to it. Some sequences of calculation or demonstrations are not given during the oral teaching - However, these documents are made in such a way that they can be used as a reference in professional life.

In 1977, no courses were devoted to energy (new energy resources or energy saving). The catalogue included 13 categories of courses and 116 different courses.

It is worthwhile remembering that the French high level education system is quite special. (Tables 1,2 summarize it.) The sub-system in which Continuing Education is given is mainly attached to the "Grandes Ecoles" line. It is the case of the one we are speaking of. The chart does not indicate that most of the teaching personnel is not attached to the school.

At the E.N.S.A.E. there are only 12 full-time professors for 450 students but some 400 professors and assistants cooperate with the schools on a part-time basis. They come from Industry or the technical services of the Government. We believe that this kind of education is good because courses are constantly up-dated and no long term contract binds the professors to the school. If the results are good, the annual contract is renewed; if results are bad (few participants) the contract is not renewed.

About 2000 participants attend the courses each year :

- 66% from industry
- 30% from civil or military administration
- 3% from foreign countries

The average age is 40 :

- 28% are under 30
- 56% are between 30 and 40
- 16% are over 40

The main differences between initial formation and continuous education, as far as we see them, are :

- the average age of participants : 22 for students, around 40 for engineers
- no experience of professional life for the former; 15 to 20 years of practice for the latter
- a weak interest for students, very strong for engineers who have precise problems to solve.

Whereas in an upper academy, a professor can assume alone for several months the course itself, on the basis of one lecture and one session exercise a week, without boring the audience, it is boring for participants in short courses to hear the same lecturer for five days in succession and six hours a day. Furthermore, this lecturer is not necessarily competent in every matter and very often participants put forward precise questions for which they are expecting answers.

It is therefore important that the teaching staff of a course should be composed of several speakers having a deep knowledge of certain topics of the programme. Their number depends on the duration of the course : 2 for 3 days, 4 for 5 days, 6 for 2 weeks.

2. The present program (Jan 1978 - July 1978)

The Working Group we were speaking of in Para. 1 was composed of people from Industry, from the "Delegation pour les Economies d'Energie" (i.e. Government Energy Saving Office), from the "Delegation pour les Economies de matières premières" (Raw materials savings delegation) from the "Delegation pour la sauvegarde de la nature" (Government Ecology Office) and from people attached to Universities and Great schools".

Two levels were recommended :

a. for immediate action, it was recognized that only continuing education could be efficient because it concerns engineers who have responsibilities and lectures could be implemented within a few months.

b. for intermediate action (3 to 5 years) it was recognized that teaching through "Great Schools" and Universities could be efficient, mainly due to a re-thinking of most lectures.

Just one word about the second point : Energy saving should not be taught to engineers as specific lectures but should be included in many courses in giving new views on energy saving. Proposals have been made to develop in all the technical courses :

- the improvement of thermodynamic cycle efficiency with a particular interest in the cost of peaks (peaks for power generation as well as transportation)
- the consideration of the re-cycling of energy or materials - A quantitative balance is not sufficient because of the difficulties of exchanging heat when the temperature differences are too small.
- the automatic control when energy use is integrated into optimization criteria.
- though non technical good knowledge of bank credit and aids given by the Government or Agencies is useful to design or redesign engineering systems.

Coming back to the role of continuing education, we will briefly give some details to show how an energy lecture series has been implemented since 1976.

Prior to that year, the catalog of courses did not show any topics devoted to energy.

In 1976, a 2 week course was offered on solar energy.

The course was reconducted in 1977 without major changes and the number of participants (16) was good (the average number of participants per course is 12).

In 1977-1978, two sets of courses were offered :

- P.01 courses : solar energy

A two week course, one week in Paris and one week in Toulouse because visits of the Odeillo laboratory and solar houses are programmed.

The program of this course is given in Annex.

- P.02 courses : energetic resources and optimization of their use

A two week program, the detail of which is given in the Annex. Attendance at these courses was good (14 and 16). It was a surprise that most of the participants came from Government technical services or agencies, few from Industry.

As mentioned above, round tables with the participants are mandatory. They help the organizators to improve the content of the course for the next year. Last year, the round tables of the P.02 course were very fruitful. From them, the 1978 - 1979 program was issued as follows :

- P.01 : solar energy

A course along the same lines as courses given during the three previous years

P.20 : energetic resources

(estimation of their amount and how to optimize these resources). It is a one week course which is mainly descriptive.

a) geo-economy of energy
b) properties of the various types of energy
c) rules to optimize the use of energy
   (no specific theory or computation is given here)

Details of the courses are given in the Annex.

- P.21 : Thermodynamics applied to energy use optimization

It is a one week course which is placed at theory and applied levels (see the annex for details).

- P.22 : energy storage

It is a one week course which reviews and analyzes the various methods of energy storage and how to store or re-store energy for each specific means of storage.

See the annex for details.

- P.30 : raw material and energy

(optimization of their use)

It is a three day course which relates material elaboration to energy consumption. The notion of energy contained in materials is developed.

See the Annex for details.

3. CONCLUSION

We think that the role of continuing education in energy saving problems is of prime importance for the reasons given above, i.e actions upon people who have responsibilities, and fast implementation of subject to fit the demand.

The S.A.E. who is sponsoring the lectures given by the "Ecole Nationale Supérieure de l'Aéronautique et de l'Espace" and the "Ecole Nationale Supérieure des Techniques Avancées" has certainly a leadership in this matter. Nowadays many other schools offer similar programs and we can assume that more than 150 engineers per year are recycled in these matters. First results might appear now; however, it will be very difficult to determine the part which is due to continuing education and the part due to other incentive actions promoted by the Government.

It must be noted that energy consumption has dropped of 3% over one full year though industrial development as well as individual comfort increased over the same period (by comparison of estimated consumption one year before).

PLACE DANS L'ENSEIGNEMENT SUPERIEUR

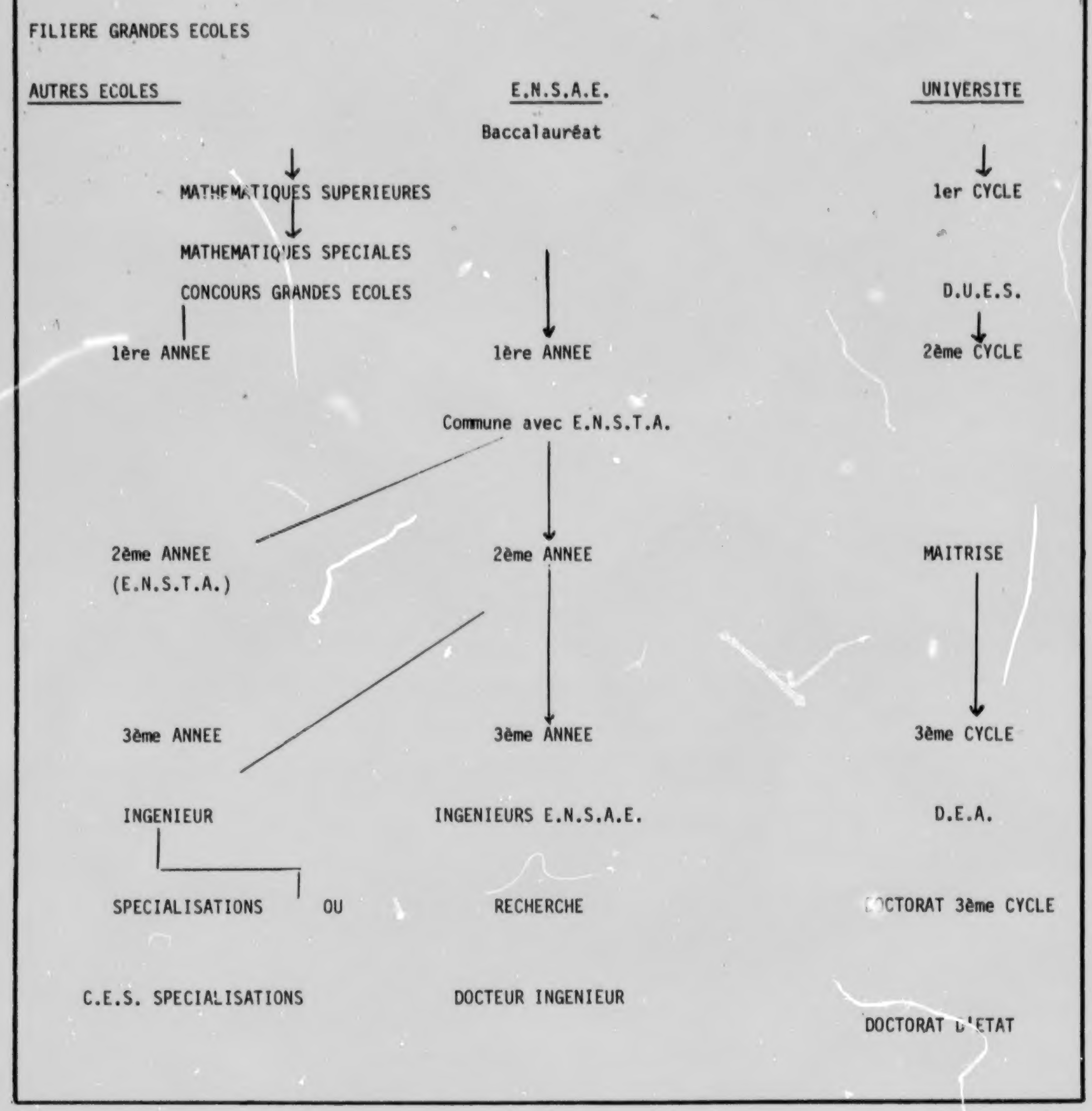

FILIERE GRANDES ECOLES
AUTRES ECOLES
E.N.S.A.E.
UNIVERSITE
Baccalauréat
MATHEMATIQUES SUPERIEURES
1er CYCLE
MATHEMATIQUES SPECIALES
CONCOURS GRANDES ECOLES
D.U.E.S.
1ère ANNEE
1ère ANNEE
2ème CYCLE
Commune avec E.N.S.T.A.
2ème ANNEE
(E.N.S.T.A.)
2ème ANNEE
MAITRISE
3ème ANNEE
3ème ANNEE
3ème CYCLE
INGENIEUR
INGENIEURS E.N.S.A.E.
D.E.A.
SPECIALISATIONS
OU
RECHERCHE
DOCTORAT 3ème CYCLE
C.E.S. SPECIALISATIONS
DOCTEUR INGENIEUR
DOCTORAT D'ETAT

TABLE 1

ENSEIGNEMENT (*EDUCATION)*

I. CYCLE NORMAL - *1ère année /1st year*
normal cycle

Enseignement commun *(common teaching)*

Entrée directe

Elèves ENSTA

2ème année *2nd year*	Enseignement Commun (55%) *common teaching*		
	Orientation / ORIENTATION		AVIONIQUE *avionics* (2 AVI)
	AVIONS MISSILES *aircraft / missiles* ESPACE (2 AM) *space*	PROPULSION *propulsion systems* FUSEES *rocket engines*	
3ème année *3rd year*	Enseignement Commun (50 %)		Option Avionique (3 AVI)
	option		
	AVIONS/MISSILES/ESPACE (3 AME) FILIERES - *courses* AVIONS - MISSILES ESPACE *aircraft - missiles* *space*	PROPULSION (3 PR) FILIERES - *courses* PROPULSION FUSEES *propulsion - rockets*	FILIERES - *courses* AUTOMATIQUE - RADARS *automatics - radars*

II. SPECIALISATIONS
specializations

Durée des Etudes : 1 année scolaire
Duration of the studies : 1 academic year

AUTOMATIQUE AVANCEE (P.A.E.) - *ADVANCED AUTOMATICS (P.A.E.)*
INFORMATIQUE (P. IN) - *INFORMATIC SYSTEMS*
MECANIQUE AEROSPATIALE (P. MA) - *AEROSPACE MECHANICS*
SYSTEMES (P. SY) - *SYSTEMS*

III. CYCLE "DOCTEUR-INGENIEUR" *(DOCTOR IN ENGINEERING CYCLE)*

Durée du cycle 3 ans (2 ans sous certaines conditions)
Duration of the cycle 3 years (under certain conditions : 2 years)

TECHNIQUES INFORMATIQUES - MECANIQUE APPLIQUEE - ELECTRONIQUE APPLIQUEE - AUTOMATIQUE ET SYSTEME
Informatic technics *applied mechanics* *applied electronics* *automatics and systems*

TABLE 2

ANNEX

P - ENERGY COURSES

N° and duration	TOWN - Date	Title of the Course	Responsible teacher	Purpose of the course
P.01 10 days	1st part in Paris 12 - 16 March 2nd part in Toulouse 26 - 30 March	Solar energy	MM. PELEGRIN & GRELLIER	Give the necessary knowledge to evaluate the interest of using solar energy, determining the cost/efficiency balance-sheet, and conceive a system for using this energy
P.03 5 days	Paris 29 Jan/2 Feb	Gas turbines	MM. BOUDIGUES' RAVAGLI and LESCOP	Present to non specialized engineers the main technical and scientific disciplines set to work in aeronautic, naval and industrial gas turbines
P.20 5 days	Paris 8 - 12 Jan	Energetic resources, census and optimal use guide	M. PELEGRIN	Provide on the one hand the rate statistics data on world energetic resources and on the other hand the rules for an optimal use of energy
P.21 5 days	Paris 12-16 Feb.	Applied Thermodynamics to energy optimal use	MM. PELEGRIN & CALVET	Give to engineers a good review of their knowledge in applied thermodynamics with a view of studying optimization concrete case of energetical resources
P.22 5 days	Toulouse 5 - 9 March	Energy stockage	MM. PELEGRIN & CALVET	Economical Justification of the necessity of the energy stockage and study of the possible solutions (yield - cost, ...)
P.30 3 days	Paris 27 Feb - 1st March	Raw materials and energy use optimization	M. PELEGRIN	Show the links which exist between raw materials and energy in view of a greater optimization of natural resources

Marc PELEGRIN

Graduated from
Ecole Polytechnique Paris 1946
Ecole Nationale Supérieure de l'Aéronautique Paris 1949
M.I.T. 1950
Dr es Sc 1952, Paris
In charge of Guidance of aircraft and simulators
Prof. at Ecole Nationale Supérieure de l'Aéronautique
Director of Ecole Nationale Supérieure de l'Aéronautique et de l'Espace from 1968 to 1978
Director fo CERT from 1968
Foreign Associate member of N.A.E. (Washington, 1978).

SELF-DEVELOPMENT THROUGH LIFELONG LEARNING

John B. Holden
Director, Graduate School
U.S. Department of Agriculture
Washington, D.C.

SUMMARY

"Self-Development Through Lifelong Learning" deals with career improvement and initiating a positive self-perspective. The overall objective of this self-instructional program would be to review and develop work incentives for professional staff to make the relationship between career satisfaction and career productivity and to examine factors which contribute to developing and maintaining a positive self-perspective towards work and self and establishing a self-improvement career plan.

As an adult--an engineer--a manager--or an administrator, are you preparing for the future?

If you are an engineer who has been out of school for 5 to 7 years, half of what you have been taught may need updating.

Many jobs today continously demand new skills. Few workers now remain in one job, or even in one career, for a lifetime. In fact, in our modern world, no amount of early education can give people all the skills and knowledge they need to function effectively throughout life.

What I am suggesting is that every person today is in need of lifelong learning. I am suggesting that lifelong learning is necessary for career development and for personal development. And I am suggesting that you develop a self-improvement career plan.

What is lifelong learning? It is exactly what the name implies, encompassing preschool, elementary, and secondary education--the "preparatory" education for youth; post-secondary education for young adults--typically trade, vocational, and technical training, as well as university education; and finally the continuing education for adults which is the major portion of lifelong learning.

Lifelong learning includes not only a vertical time dimension--literally from birth to death, but also a horizontal dimension encompassing all fields of knowledge, and an inner dimension that reflects the personal growth needs of human beings for self-expression and dignity.

Learning for adults--in continuing education is different from that provided to youngsters during their formal schooling. The adult learner, to begin with, has less time to give to formal learning procedures. He probably has an idea of what he wants and a self-perception that will limit or expand the horizon of learning.

The adult learner, with his multitude of experiences, takes an active part in determining what he wants to learn and how he will learn it. He will help choose educational goals, content, methods, and means of assessment.

Continuing education has a new and challenging role to play in the work and personal life of adults. Not only can it help fill needs for knowledge and skill but perhaps even more important it can also help adults find avenues for personal growth and enrichment.

It is my contention that lifelong learning must be made a pervasive influence to aid those who must make today's critical decisions and choices in guiding present events as well as setting the course for the future.

To expand learning opportunities for adults today, I believe we must provide for more flexibility in integrating work with education and for supplementing both throughout the life span.

In my country, the Federal Government requires each agency to inventory the educational needs of all workers each year and to provide that need within the agency. If it can't be done within that agency, they may try to do it with another agency or agencies. If this is not practical, they may go outside the government and contract for such training.

Let me tell you about some of the new directions in which we are trying to move in my country. One of these we call "multiple dimensions of learning".

To illustrate what is meant by this term, I will use a program we developed in the Graduate School, U.S. Department of Agriculture, called "Critical Issues and Decisions". The purpose of this program is to encourage Federal executives to take a look at the past in the fields of art, literature, philosophy, economics, political science to see in what way we can draw upon the past in order to relate ourselves to the critical issues of today.

How do we accomplish this? Well, the first dimension is through reading. Carefully selected handouts and one or two paperback books on each topic are assigned.

The second dimension is group discussion to test their interpretation of the reading and ideas gained from experience with other Federal executives in the seminar group. The third dimension involves listening to an outstanding scholar specialized in this particular field, followed by a roundtable discussion with him. The fourth dimension involves using closed circuit television. Some of the participants actually appear on television with the scholar while others watch the discussions.

Another dimension involves a playback of the telecast of their discussion with the scholar on TV. You can see yourself reacting with others.

Did you listen well? Were you comments appropriate? Did you help move the discussion ahead with more penetrating thoughts or did you get off on a tangent?

Let me use another example of a type of educational program conducted by the Graduate School. The program is our three-phase Management Development Program for Federal executives. Here we use the workshop approach. We bring together for two days a group of scientists, engineers, or people who have recently been appointed to administrative positions and ask them to inventory the problems they face as executives in the Federal government. Once these problems are identified, the participants are then asked to help in the planning of their learning experiences to meet their needs as they see them. Then we take 3 months to plan the program and bring the participants back to live in a residential center or hotel where they spend 9 days trying to learn from each other and the various resource people invited to meet with them. Toward the end of this 9-day period, they select a problem that they have back on the job and begin to plan how they might solve that problem. They test out their plans with each other and return to their job to put the plan in practice for two or three months. The third phase of the program involves a two-day meeting some 3 months after the workshop. They also share their failures. Since we learn from mistakes, this too, is a valuable dimension of learning.

Here we have a program tailor-made for adults. The program is focused upon real needs and problems. The adults plan their own learning experiences to solve some of their problems and to satisfy their needs.

Another Graduate School product that I want to share with you is the Self-Development Checklist. I am providing this for your personal use in assessing and planning for your continued growth and effectiveness as an engineer, administrator or manager.

It will provide you with a self-analysis of your training and developmental needs and help you to take a good hard, but honest, look at yourself and your previous experiences and training in supervision and management. You should be objective as possible as you answer each item. Once you have completed the checklist, it will help you decide what you will do during the coming year to further your growth and development. You can write down what you intend doing and set target dates for accomplishment.

We have found it helps to get a view of how others see you and your training needs. Ask your boss or someone you respect as an engineer, administrator, or manager to fill another copy of the checklist for you.

If you are like most people, you fail to see yourself exactly as others see you. To an engineer, administrator, manager, or executive who must get work done with and through people, self-insight and sensitivity to how others react to your leadership is vital to your effectivness.

I you have asked someone else to fill out a checklist as he sees you, be sure to follow through. Compare your answers with his and look for where you and he differ. These areas of difference may well offer the greatest prospects for your future development as an engineer, administrator, manager, or executive.

Using and updating this checklist at least annually can do much to keep you growing and developing in your leadership roles. The follow-through (lifelong learning) is up to you.

It takes a long time to grow an engineer or an executive. Time and experience alone are not enough.

College and university courses in business and public administration may help, but these too, are not enough.

Follow-up or continuing education courses and management seminars taken periodically throughout one's career, while helpful, also are not enough.

Even experience in the different functional areas of running organizations or getting things done with and through people are not enough.

What is needed (besides time and variety of managerial experiences with real problems) is the capacity to learn and profit from managerial and engineering experiences.

Some of this ability to profit from past experiences in managerial problem-solving and decision-making may come from within the individual himself.

Of equal value, perhaps, is the feedback, counselling, coaching, and help one can get from good bosses who "teach by example "--bosses who create and maintain a climate conducive to the continual growth and development of people.

In short, one of the best ways to learn to be an effective and efficient engineer is to learn by doing, by managing, by tackling real problems in real organizations, ideally under a good boss or set of bosses who plan and provide purposeful and progressively more responsible and varied learning experiences for the potential engineer.

While we are all familiar with the old saying "You can't teach an old dog new tricks," there is a corollary that applies to executive development, "There are some tricks that only an old dog can learn."

The judgment and perspective that result from the "school of hard knocks" rank among the "tricks that only an old dog can learn."

The professional engineers must be preparing themselves to solve persistent problems of engineering nature as well as develop the human skills and interdisciplinary knowledge to solve today's complex problems. The top engineer must be a "team member" one who can help bring all the elements and factors of economic development together to improve the quality of life for all the people.

Whatever we do, let us not become victims of obsolescence. Today, a man can not grow old in a world familiar to him as a youth. The only person who can be sure of escaping obsolescence is one who continues to develop his potentials--a learning individual who can and will adapt to change;--a person looking to and preparing for the future, not one who is backing into the future.

I will always remember that Mrs. Eleanor Roosevelt said everything she did, every place she went, she looked upon it as a learning opportunity. Continuing education then, is self-realization and self-fulfillment.

Lifelong learning can give us a feeling of significance, a sense of direction, a sense of being connected with the vital issues of today, making us knowledgeable and active citizens in the free society moving towards the future and living a full and zestful life. Modern society does not live by asking is everybody happy, but is everybody learning?

Some updated and revised material for the speech from the following:

[1] Fulker, Edmund N., "A Model and Checklist for Administrator, Manager, and Executive Career Training and Development," Developing State and Local Leadership in a Changing Society, Graduate School, U.S.D.A., Washington, D.C., 1972, pp. 78-90.

Self-Development Checklist

	I am doing quite well	I can use more on-the-job training and experience	I should do more through self-study, self-effort, reading etc.	I need some formal group training	Does not apply
Level A *Subject matter Knowledge, Abilities, and Skills*	(You may wish to check more than one)				
1. In the substantive or subject matter field in which I am functioning as a supervisor, administrator, manager or executive	☐	☐	☐	☐	☐
Level B *Human Relations Knowledge, Abilities, and Skills*					
2. Self-insight and self-knowledge	☐	☐	☐	☐	☐
3. Interpersonal sensitivity (awareness of how you affect others and how they make you feel and react)	☐	☐	☐	☐	☐
4. Group process and leadership	☐	☐	☐	☐	☐
5. Motivating, training and bringing about change	☐	☐	☐	☐	☐
6. Intergroup relationships	☐	☐	☐	☐	☐
7. Diagnostic and group problem-solving, confrontation, and conflict resolution	☐	☐	☐	☐	☐
8. High standards and ethics and setting a good example	☐	☐	☐	☐	☐
9. Effective listening	☐	☐	☐	☐	☐
10. Efficient reading	☐	☐	☐	☐	☐
11. Interviewing	☐	☐	☐	☐	☐

Self-Development Checklist–*Continued*

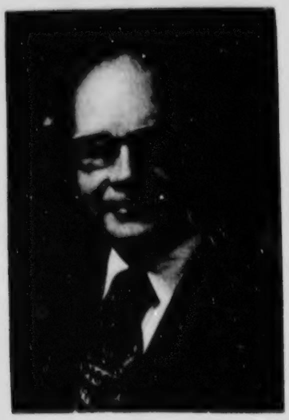
	I am doing quite well	I can use more on-the-job training and experience	I should do more through self-study, self-effort, reading etc.	I need some formal group training	Does not apply
Level C *Technical Managerial Knowledge, Abilities, and Skills*					
12. Writing letters, memos, reports	☐	☐	☐	☐	☐
13. Speaking before groups	☐	☐	☐	☐	☐
14. Conference-leading and conducting meetings	☐	☐	☐	☐	☐
15. Habits of planning my work and use of my time	☐	☐	☐	☐	☐
16. Scheduling my work and work of others	☐	☐	☐	☐	☐
17. Organizing my unit, section, or group for optimum effectiveness	☐	☐	☐	☐	☐
18. Developing and effectively using budgets to get results	☐	☐	☐	☐	☐
19. Controlling, following-up, and keeping work under control	☐	☐	☐	☐	☐
20. Measuring and evaluating the effectiveness of work plans and unit accomplishments toward agreed-upon goals and objectives	☐	☐	☐	☐	☐
21. Delegating significant areas of responsibility for results to others	☐	☐	☐	☐	☐

Self-Development Checklist–*Continued*

	I am doing quite well	I can use more on-the-job training and experience	I should do more through self-study, self-effort, reading etc.	I need some formal group training	Does not apply
22. Reaching decisions systematically and through involvement of those who will be required to implement and carry out the decisions	☐	☐	☐	☐	☐
23. Selecting and placing workers where they will optimize their contributions to the organization and at the same time achieve satisfaction of their important individual needs	☐	☐	☐	☐	☐
24. Coordinating: Keeping other units and individuals informed about progress and potential problems before emergencies, antagonisms, and ineffectiveness develop	☐	☐	☐	☐	☐
25. Integrating: Serving as the linking-pin and gobetween in fusing the efforts of individuals and my unit with efforts of others in the organization	☐	☐	☐	☐	☐
26. Information systems: Knowledge of, familiarity with, and systematic use of data input and output needed on a timely basis to effectively manage my unit	☐	☐	☐	☐	☐

Self-Development Checklist–*Continued*

	I am doing quite well	I can use more on-the-job training and experience	I should do more through self-study, self-effort, reading etc.	I need some formal group training	Does not apply
27. Quantitative: Knowledge of, and familiarity with, current concepts of mathematics, statistics, cost benefit analysis, automatic data processing, PERT, etc.	☐	☐	☐	☐	☐
28. Methods improvement: Knowledge of, and familiarity with, time and motion, surveys, work layout, etc.	☐	☐	☐	☐	☐
Level D *Conceptual Knowledge, Abilities, and Skills*					
29. Broad perspective–liberal education	☐	☐	☐	☐	☐
30. Generalist viewpoint; national, international perspective	☐	☐	☐	☐	☐
31. Political, social, economic knowledge and sensitivity	☐	☐	☐	☐	☐
32. Systems concept and approach	☐	☐	☐	☐	☐
33. Ability to see the big picture, future oriented	☐	☐	☐	☐	☐



Dr. John B. Holden, adult educator received his Ph.D. at the Ohio State University in 1955. He has been a consultant of continuing education at Michigan State University from 1950-56; a specialist of general adult education at the U. S. Office of Education from 1956-58; and for the past 20 years, the Director of the Graduate School, U. S. Department of Agriculture. He has been active in adult education, has served as president of state groups and as President of the American Education Association. He has been recognized for his outstanding leadership in the field by the National Association of Public and Continuing Education, the State of Michigan and Ohio University. He was the recipient of the Delbert Clark Adult Education Award. He has contributed widely to literature and research in the field of education; the author of "Score Card for Community Adult Education Programs," "A Learning Community" in Materials and Methods, and other articles.

PROJECT SATELLITE — AN EXPERIMENT IN CONTINUING EDUCATION OF ENGINEERS IN THE WEST INDIES

Myron W. Chin
Chairman, Continuing Education Committee
Faculty of Engineering
University of the West Indies
Trinidad

Summary

This paper presents some of the results of an experimental satellite programme utilizing two of the Applications Technology Satellites viz. ATS-3 ATS-6 which was conducted by the University of the West Indies (UWI) in collaboration with the United States Agency for International Development (USAID) and others in early 1978. A brief review of the use of such satellites for educational and community purposes is first given and the possibilities of benefits from such technology for the Caribbean region with particular reference to the continuing education of engineers are explored. Although a wide range of activities was undertaken as part of the experimental satellite project, only the results of the engineering activities are highlighted in this paper together with a brief description of the system used and some of the major problems encountered.

The paper concludes that satellite communications are both technically possible and desirable for the West Indies and can have an enormous impact on improving and broadening university programmes in the region not only in the continuing engineering educational field but in other educational fields. However, it is recommended that a detailed feasibility study should first be undertaken to assess the cost effectiveness of such a delivery system before any firm decisions can be made.

Introduction

The University of the West Indies is an international institution of Higher Education dedicated to teaching and research and to the development of the Caribbean region. It serves fourteen different English-speaking West Indian territories and also provides some services to Guyana despite the fact that it has its own University of Guyana. The territories of the region comprise a series of islands forming an arc along the Eastern end of the Caribbean Sea ranging from Jamaica in the North to Trinidad and Tobago in the South just off the Venezuelan coastline and includes the co-operative republic of Guyana in South America and Belize in Central America. The distances are substantial : Belize for example, is approximately 700 miles from Jamaica which in turn is 1,000 miles from Trinidad. Excluding Guyana and Belize, the combined area of the West Indies is 7,733 square miles. The area of Guyana is 83,000 square miles and that of Belize is 8,866 square miles. The total population of the region is about 4.6 million with an age distribution which is skewed towards the young. Education, particularly higher education, is at a premium and less than one percent of the regions's labour force are University graduates. The demand for education and training, formal and non-formal, continues to grow but programmes are severly constrained by restricted finances and limited manpower.

Growth of the University

The University, formerly the University College of the West Indies, began operations in 1948 in affiliation with the University of London. It became an independent University under a Royal Charter granted by Queen Elizabeth II in 1962.

From a single Faculty - the Faculty of Medicine in 1948 with 33 students, the University has grown to a three-campus institution with eight Faculties - Agriculture, Arts and General Studies, Education, Engineering, Law, Natural Sciences, Medicine, and Social Sciences - with nearly 8,000 students, of whom about 8% are postgraduates. The rate of growth of student numbers increased rapidly after 1958 and in the fifteen years from 1961 to 1976 the student population increased by a factor of about eight. For the 1977/78 session a breakdown of student enrollment by campus was as follows:-

Mona Campus in Jamaica	- 4291
Cave Hill Campus in Barbados	- 1261
St. Augustine Campus in Trinidad	- 2477
Total	8029

The Faculty of Engineering was established in October [illegible] at the St. Augustine Campus in Trinidad [illegible] an initial enrollment of twenty eight students and since then there has been a steady increase in the number of students and graduates as can be seen from Figure 1 which gives an indication of the annual total number of graduates from 1964 to 1978 by discipline. For the period 1964 to 1978 there was a total of 1041 graduates. Table 1 gives a territorial breakdown of the total number of graduates by discipline for the period 1964-1977. It can be seen that Civil Engineers account for the greatest number of graduates followed by Mechanical and Electrical Engineers. It should be noted from Table 1 that most graduates come from the three main island territories of Jamaica, Barbados and Trinidad and Tobago.

The first phase of a major expanrion of the Faculty of Engineering which is being funded by the Trinidad and Tobago Government is currently in progress and it is expected to be completed by 1980. This will cater for an increased student enrollment in the four traditional areas - Chemical, Civil, Electrical and Mechanical and also in the new areas of Agricultural, Industrial and Petroleum Engineering. It will also include postgraduate, continuing education and extension service programmes in Construction Engineering and Management, Petroleum Engineering, Production Engineering and Management and Electronics and Instrumentation. The latest statistics of actual and projected student enrollment in the various programmes are given in Appendix 1.

Student Per Capita Costs

Associated with this rapid growth of the University is the steady rise in the student per capita cost e.g. in the Faculty of Engineering the average cost per student termed the economic cost has increased from US$1817 in 1971/72 to US$4443 in 1976/77. In this connection the University has appreciated the problem of financing and has made and are continuing to make attempts to provide solutions. One possible solution is to examine the benefits which increased uses of newer electronic technologies could provide and since education in the caribbean essentially involves communications over large distances, telecommunications by satellite seems worthy of serious investigation. Project satellite was intended to explore such a possible solution. However, before describing some of the results of this satellite experiment it is perhaps appropriate at this point to first of all briefly review the use of such satellites for continuing education purposes.

The Use of Satellites for Continuing Education

The use of satellites for Continuing Education purposes was made possible just over twelve years ago with the launching on December 7, 1966 of the first of a series of six Applications Technology Satellites (ATS) known as ATS-1.

The satellites of this series were planned for geostationary orbit, i.e., a height of 22,300 miles over the Equator. At this height a satellite has the same rotational speed as a point on the equator and appears to hang stationary in space when viewed from the Earth. They are stabilised so that the space crafts' antennas maintain a fix orientation with respect to Earth so that all beams can be directed with precision. The ATS spacecraft contain powerful subsystems which make broadcasts between low cost ground stations possible. This eliminates the large expensive tracking dishes necessary for communications using the usual commercial satellites.

The second ATS-2 was launched on April 6, 1967 but was unsuccessful. The third ATS-3 took up its station over the Atlantic Ocean on November 6, 1967 and is still in orbit and still extensively used by many U.S. based universities/research centres. Project Satellite worked with three ATS-3 terminals one on each site. ATS-3 is now on station in a "gravity well" over the equator at 105°W. The fourth ATS-4 was unsuccessful after launching on August 10, 1968. The fifth ATS-5 was successfully launched on August 12, 1969 and has since been providing a large quantity of useful and valuable data. The last satellite in the Applications Technology Series ATS-6 was launched on May 30, 1974 and placed on station over the Equator at 94°W Longitude about 6½ hours after launch. It is a remarkable spacecraft and the fore-runner of a new generation of communications satellites. The spacecraft weighs 3,090 lbs., is 26 feet high and, with the solar array booms extended, is 52 ft. across at its widest point. The solar arrays contain over 21,000 solar cells which are used to power the satellite's command, propulsion, attitude control, and experimental mechanisms. ATS-6 carries a 30 ft. diameter antenna which can be directed to within $1/10^{\circ}$ of an arc and allows the relay of strong television signals directly to suitable small and inexpensive television receivers on the ground.

Since launch these satellites have been used extensively by the United States and other countries for scientific experiments, meteorological studies, continuing education and other social services, etc. But the use of satellites for purposes such as these has by no means been confined to the United States and other developed countries.

PEACESAT

In 1971 a consortium of users initiated the world's first international health and educational network using ATS-1. This project is known as the

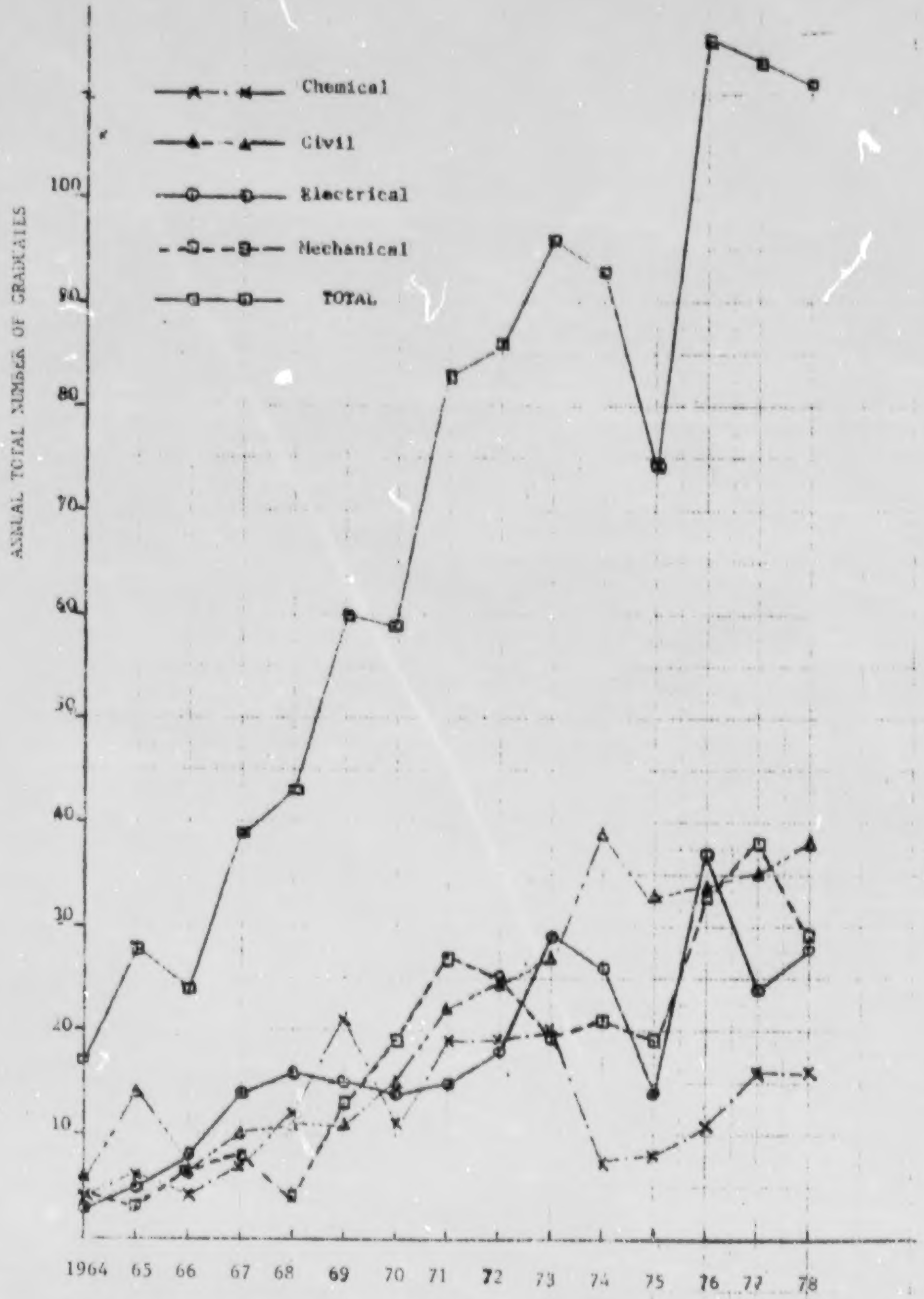


FIG. I ANNUAL TOTAL NUMBER OF ENGINEERING GRADUATES
U.W.I. 1964-1978

TABLE I

NUMBER OF GRADUATES BY DISCIPLINE AND BY TERRITORY 1964-77

TERRITORY	DISCIPLINE			
	Chemical	Civil	Electrical	Mechanical
Antigua	2	6	4	1
Bahamas	1	1	2	-
Barbados	13	22	12	3
Belize	1	7	6	5
Br. Virgin Islands	-	1	-	-
Cayman Is.	-	2	-	-
Dominica	-	5	1	1
Grenada	2	9	6	1
Jamaica	48	121	90	96
Montserrat	-	1	2	-
St. Kitts	1	2	1	-
St. Lucia	2	9	-	-
St. Vincent	-	3	2	2
Trinidad & Tobago	82	79	99	108
Guyana	10	19	11	22
United Kingdom	-	-	-	-
Other	3	-	2	[illegible]
	165	287	238	240

TOTAL FOR
1964 - 1977 - 930
1978 - 111
1041

PEACESAT (Pan Pacific Education and Communication Experiments by Satellite) and currently links educational institutions in 12 nations. The project uses small, low cost ground terminals coordinated by Honolulu, Hawaii. Locally owned satellite terminals are operated at Honiara, British Solomon Islands; Rarotonga, Cook Islands; Suva, Fiji, Tarawa, Gilbert Islands; Honolulu and Maui, Hawaii, Nuku'alofa, Kingdom of Tonga; Noumea, New Caledonia; Vila, New Hebrides; Wellington, New Zealand; Niue Island; Lae and Port Moresby, Paupa New Guinea; Saipan, Trust Territory of the Pacific Islands; Santa Cruz, California; Pago Pago, American Samoa; Apia, Western Australia; and Sydney, Australia. A large number of programmes in health, nutrition, education and training are transmitted. ATS-1 is also used by the University of the South Pacific for courses for credit, and was used in the Pacific-Caribbean link-up during Project Satellite.

Early use of ATS-6 in the U.S.A.

The large scale use of television in educational, medical and other programmes became possible with the launching of ATS-6. During its first year 600 elementary school teachers in 8 Appalachian states used the satellite for graduate studies programmes. Educational programmes were also relayed to junior high school students in the Rocky Mountain states and to teachers in Alaska.

The Indian Experiment (Site)

In May 1975, ATS-6 began moving from its station on 94°W Longitude on Earth command to a site over Kenya for use in the Satellite Instructional Experiment (SITE) of the Indian Government. It arrived at its new station (35°E) on July 1, 1975, and the SITE experiment began one month later. In this experiment ATS-6 received video signals from Ahmedabad (prime) and Delhi (back-up) and relayed them to 6 clusters of direct receive stations - 2,400 sites in six states simultaneoulsy.

The Indian Government had two sets of objectives which can be classed as (a) instructional (b) technical.

(a) Instructional Objectives

(1) To contribute to family planning objectives.
(2) To improve agricultural practices.
(3) To contribute to national integration.
(4) To contribute to general school and adult education.
(5) To contribute to teacher training.
(6) To improve occupational skills.
(7) To improve health and hygiene.

(b) Technical Objectives

(1) To provide a system test of broadcast satellite television for national development.
(2) To enhance capability in the design, manufacture, deployment, installation, operation, and maintenance of of broadcast and distribution facilities.
(3) To examine matters such as:-
   (a) optimum receiver density, distribution and scheduling;
   (b) techniques of audience attraction and organization;
   (c) the problems involved in developing, preparing, presenting and transmitting program material.

Morning programmes were broadcast six days per week, 1½ hr. each day, primarily aimed at the in-school 5-12 year age group and teacher training for about 96,000 teachers. Evening programmes, broadcast 2½ hrs. daily for 7 days weekly, were primarily for education in the villages.

It is reported that the one-year long experiment was highly successful and that the results achieved would have required the efforts of four generations. The work will be continued using India's own satellites.

Indonesia

In Indonesia education by satellite has now been accepted as feasible. The 13,000 islands of the archipelago are now linked with their own satellite system.

Possibilities for the West Indies

The apparent success of programmes elsewhere, the circumstances of the Caribbean, and of the University of the West Indies, seemed to make it important to assess or at least to introduce to our community, possibilities of benefits which the modern educational technologies, including satellites, may make possible. Project Satellite was an effort to do this.

Objectives of Project Satellite

The objectives of Project Satellite were to determine:-

(1) the feasibility of delivering continuing education programmes to the widely scattered countries in the region served by the University;
(2) the level of user acceptance - and enthusiasm - generated by the technology;
(3) the usefulness of satellite madiated video lecture courses;
(4) the value of teleconferencing and consultation by satellite as an effective co-ordinating activity for teaching, research and administration.

The programme was designed to meet these objectives as far as was possible and therefore covered a wide range of activities.

However, prior to the actual start of the experimental programme a great deal of pre-planning and organization was necessary and this involved several meetings between the collaborating organizations such as the Academy for Educational Development (A.E.D.) USAID, NASA and UWI amongst others in order to define specific areas of responsibilities. In addition, tests had to be carried out at the four selected sites in Jamaica, Barbados, St. Lucia and Trinidad in order to ensure that the ATS-6 antennae would have an unimpeded line of sight to the satellite. Full details of the planning and testing are given elsewhere (1).

Highlights of Engineering Activities

The overall programme was conducted over a period of approximately two months from mid January to mid- March 1978 and covered some twenty eight sessions of 45 to 90 minutes on a wide range of topics such as family life education, agricultural research in integrated rural development, construction management and the small contractor in the West Indies and solar energy. The last two mentioned topics are of particular interest to engineers and some of the highlights of these two activities are now given.

Teleconference on Construction Management and the Small Contractor in the West Indies

This was originally planned as a continuing education seminar whereby the three campuses would be linked by satellite. However because of the refusal of the Trinidad and Tobago Government to grant permission to use certain frequencies it was not possible for the St. Augustine Campus to participate in the experiment. As a result the seminar was conducted between the two remaining Campuses at Mona Jamaica and Cave Hill in Barbados and St. Lucia which participated for the first time in the project. This also necessitated the video recording in Trinidad of the introductory lecture which was then sent to Jamaica for transmission from Mona to Cave Hill and St. Lucia. After the introductory lecture there was a panel discussion between Mona and Cave Hill involving engineers and contractors from the two territories. Some forty engineers and contractors participated in the exercise and an evaluation was undertaken after the seminar. The majority of participants found the quality of the picture and sound from Mona and Cave Hill good and expressed a willingness to received an entire course of continuing education lectures by this means in the future.

The only problem encountered was that it was not possible to get sound from St. Lucia but this was subsequently corrected and there was a loss of sound transmission on two occasions during the teleconference.

Solar Energy Teleconference

In this programme there was a series of presentations from the Solar Energy Research Institute in Denver, Colorado, using the Denver ATS-6 terminal. There were lively interactions from the three Caribbean sites on the ATS-3 link. Two-way television was not used because of the unacceptable time lag (about 4 mins.) between transmissions. Both Video and voice reception from Denver were excellent. There was also an audience of academic staff and students, representatives from research and applied fields connected with energy resources, as well as Government and other administrative personnel.

Brief Description of the System Used

One of the most remarkable features of the system is its simplicity. There were three antennas on the roof of the Senate building at Mona. Two of these were 3-metre dishes, one for transmission the other for reception, aimed at ATS-6. The third antenna - a crossed Yagi which looks rather like a complex home television receiving antenna - was used for ATS-3.

The television uplink went out from Mona on S-band at 2250 Giga Hertz using 200 watts of power. On receipt by ATS-6 this signal is amplified, converted to 860 Megahertz and retransmitted on the down link to the Caribbean to the receiving antennas in Cave Hill, in St. Lucia, and at Mona. The Mona link was used for monitoring the quality of reception from ATS-6.

The voice link used ATS-3. For audio only, this involved the use of small (~150 watts) VHF radios. Channels 2 and 4 were used.

The two-way audio links during televised programmes were slightly more complicated since both satellites had to be used. From the sites other than Mona the audio signal was beamed to ATS-3, received at Mona, and immediately rebroadcast on the S-band to ATS-6 for transmission to all sites.

The transmitting station would require in addition, another antenna, transmission equipment and a selection of studio equipment, e.g. lights, cameras, microphones, monitors, etc.

Concluding Remarks

From the foregoing , it can be seen that the experimental satellite project generated a great deal of interest and enthusiasm both amongst individuals and instutions in the region. In conclusion therefore it is possible to make the following comments:-

1. Some fifty one percent of the available time was used in continuing education

activities and as such was the best tested portion of the programme. From an evaluation of the results one can conclude that such a satellite system can provide an excellent delivery system for continuing education programmes.

2. Members of the various West Indian governments displayed a high level of interest and enthusiasm in the experiment and expressed the hope that in any future programmes terminals would be made available in their territories.

3. From the continuing engineering education teleconference it was generally felt that such a system could be used for Delivery of entire courses of lectures.

4. While everyone seems agreed that University programmes could be improved and broadened by use of radio and television techniques, the cost effectiveness and ability to meet the costs of the system would have to be very carefully assessed. But Project Satellite has given a hint to the region of the sort of technology now possible. The new electronics, microminiaturisation, a new materials technology, faster, cheaper and more powerful computers, etc., will alter the technology available to educators by a quantum jump which is perhaps fully comparable to that which occurred when man first learned to write.

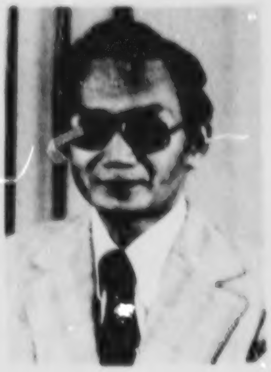
Here we have a new possible basis for another greater widening of the gap between the industrialised and the developing nations. If peoples of the Caribbean are to attempt to "keep up", because of the shortages in material or human resources we are going to have to make use of the applications of these repidly progressing fields and we are going to have to share. If Satellite technology can make this sharing easier, if the political leaders of the Caribbean and other extra-regional areas will agree to the use of this type of technology for the improvement of education, agriculture, medicine and other social services, if the necessary funds can be found, and if the countries bordering on the Caribbean can help in the sharing of this technology, Satellite communications can have an enormous impact in the region and therefore demand assessment.

Acknowledgements

The author would like to express his sincere appreciation to Professor G.C. Lalor, Pro Vice Chancellor of the University of the West Indies for his kind permission to use extracts from his very comprehensive report on the Project Satellite.

References

1. Lalor G.C. - Project Satellite Report. June 1978. University of the West Indies Report. Mona Jamaica.



MYRON W. CHIN

Dr. Myron W. Chin is Chairman of the Continuing Education Committee and Senior Lecturer in the Faculty of Engineering, University of the West Indies, (UWI), Trinidad. From 1977-78 he served as Asst. Dean of Engineering.

Dr. Chin graduated in Civil Engineering from Loughuorough University in the UK in 1962 and received his Ph.D. in Structural Engineering from Manchester University England in 1966. Prior to joining the UWI in 1972 he spent six years in the Shell Oil Company in Trinidad. He is a chartered Civil Engineer and holds professional membership in the ASCE and I.C.E. (UK).

He is the author of several technical papers and was Chairman of the First Caribbean Conference on Earthquake Engineering held in Trinidad in January 1978. He served as Rapporteur General of the UNESCO International Conference on the Education and Training of Engineers and Higher Technicians held in India in April 1973. He is currently Chairman of the Continuing Education Committee of the Council of Caribbean Engineering Organizations and a member of the UNESCO International Working Group on Continuing Education of Engineers.

APPENDIX I

STUDENT ENROLMENT

ENROLMENT IN UNDERGRADUATE DEGREE PROGRAMMES

	Traditional Areas				New Areas			Total
	Chemical	Civil	Elec.	Mech.	Agri.	Indus.	Petroleum	
Actual								
1975/76	62	110	105	109	-	-	-	386
1976/77	68	140	115	118	-	-	-	441
1977/78								
Projected								
1978/79	82	166	131	133	-	-	20	536
1979/80	82	183	133	145	6	36	11	596
1980/81	82	204	134	160	11	67	22	680
1981/82	82	218	134	195	13	78	40	760
1982/83	82	241	134	220	15	90	58	840

ENROLMENT IN POSTGRADUATE DEGREE PROGRAMME (M.Sc. M.PHIL. & PH.D)

	Traditional Areas*	New Areas					Total
		Agri. Eng.	Cont. Eng.& Mgmt.	Elect. & Inst.	Ind. Eng.	Pet. Eng.	
Actual							
1975/76	18	-	-	-	-	-	18
1976/77	23	-	-	-	-	-	23
1977/							
Projected							
1978/79	40	2	6	6	4	6	64
1979/80	44	3	8	8	6	8	77
1980/81	46	3	8	8	6	8	79
1981/82	48	3	9	9	7	9	85
1982/83	50	4	9	9	8	[illegible]	89

*Chemical, Civil, Electrical and Mechanical Engineering

PROJECTED ENROLMENT IN FULL-TIME DIPLOMA AND CERTIFICATE PROGRAMMES AND IN SHORT COURSES (NEW AREAS ONLY)

	Construction Engng. & Management			Petroleum Engineering		Electronics & Instrumentation	Production Engng. & Management
	Dip.	Cert.	Short Courses	Dip.	Short Courses	Short Courses	
Actual							
1977/78							
Projected							
1978/79	10	20	120	12	120	60	
1979/80	12	24	140	12	140	70	
1980/81	12	24	140	-	140	70	
1981/82	14	24	160	-	160	80	
1982/83	14	24	160	-	160	80	

MASTER OF ENGINEERING DEGREES BY EXTERNAL DELIVERY: THE CLEMSON UNIVERSITY PROGRAM — A CASE STUDY

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THE CLEMSON PROGRAM

Clemson University's College of Engineering is developing an externally delivered Master of Engineering Program unique in its approach to off-campus graduate education. Clemson's externally delivered Master of Engineering program of guided professional self-study, was created to meet an identified need for advanced level engineering education in South Carolina. Clemson's program will be described in an evolutionary fashion, including aspects of the program needs assessment, course and program delivery mechanism selection, course development activities and the successes identified to date.

I. THE CONTINUING ENGINEERING EDUCATION DILEMMA.

Individuals who have completed the baccalaureate degree in engineering and who are employed on a full-time basis quickly encounter the complex situation of continuous career development. While experience and self-study contribute substantial knowledge required to maintain one's professional level, the balance must be obtained through more highly leveraged formal education programs. Figure 1 illustrates graphically the situation encountered by graduate engineers.

Companies demand graduate degree opportunities for their new employees and exert pressures on academic institutions to meet these needs. Work commitments can prevent engineers from participating in degree programs offered through either conventional "locked-step" classroom or fixed-site instructional television instruction. Assignments away from their offices and/or conflicts with family, civic, and professional commitments often preclude practicing engineers of these opportunities.

Various mechanisms are available which attempt to address the problem of career obsolescence. These include correspondence courses, formal on-the-job training, non-credit short courses and seminars, evening graduate programs and, in growing instances, TV-based off-campus programs, both videotape and instructional television (ITV).

For the most part, each of these mechanisms is directed at the needs of a relatively small proportion of practicing engineers. Moreover, the videotape based graduate level courses for credit require extensive facilities for preparation and editing of tapes plus a significant capital outlay for playback/communications equipment. In TV-based systems, substantial concentrations of engineers in a few particular locations are usually required to justify presenting a specific program.

The following discussion is provided as an introduction to the problem of off-campus graduate study. In each case, the situation of widely dispersed engineers is addressed.

II. CLEMSON UNIVERSITY'S APPROACH TO CONTINUING ENGINEERING EDUCATION.

South Carolina, containing approximately three million citizens in the Southeastern part of the United States, has an engineering employment of under 10,000 dispersed over 30,000 square miles. The State is rapidly converting from an agrarian and textile-based economy to a higher technology-based economy. Many new plants have been attracted to the major seaport at Charleston, to the capital city region around Columbia, and to the northwestern Piedmont areas of the state.

Clemson's Continuing Engineering Education has expanded its seminar and short course program schedule from a total of 6 in 1970 to over 400 in 1977. Over 10,000 individuals participated in the 1977 programs. Faculty interest and motivations portend an increasing number of programs for the future.

Clemson University's commitment to continuing education in the form of short courses, seminars, and review courses is filling a real and present need to provide timely, relevant, and state-of-the-art concepts and techniques to engineers throughout South Carolina. This Continuing Engineering Education effort does not, however, address graduate study for graduate credit.

III. CLEMSON UNIVERSITY'S APPROACH TO OFF-CAMPUS GRADUATE ENGINEERING EDUCATION: THE ANALYSIS OF NEED.

Clemson's approach to external graduate education began in 1974 when the College established an evening graduate engineering program. This program offered both off campus and on campus evening courses in chemical engineering, civil engineering, electrical and computer engineering, and mechanical engineering, as well as the interdisciplinary fields of materials engineering and bioengineering. Since Clemson is located at inconvenient distances (30 miles minimum) from most large metropolitan areas of South Carolina, and coincidentally from most of the major industrial concentrations, the evening on-campus program served only a small number of local engineers. Additionally, the off-campus program was conducted using "locked-step" instruction methods which required the professor to meet with the class on a regular basis at sites remote to students one or more times a week. This method was time intensive for the instructor and not generally cost effective.

Coupled with the need for a mobile, individually paced instruction method, is the need for an instructional system to satisfy these requirements while meeting the additional constraint of maintaining the essence and quality of a truly graduate-level program. Clemson's externally delivered MENGR program is designed specifically to meet these needs and requirements.

During 1974, a partial formal, partial informal needs assessment involved numerous interviews of technical organizations and analysis of engineering employment in South Carolina. This assessment resulted in a conclusion that the available videobased graduate program was insufficient to meet the needs of practicing engineers in the State; that an additional approach was needed.

The externally delivered MENGR program, established in 1975, is design, manufacturing, and operations engineering oriented. Engineering educators having extensive industrial and/or consulting experience designed the courses.

Figure 2 illustrates the various external education alternatives examined and the relative expense for each. The individualized instruction method of education, reinforced by audio-visual materials and peer-group interaction, was selected as the most effective mechanism for our state's low density of engineers.

IV. THE EXTERNAL MASTER OF ENGINEERING PROGRAM.

The basic concept of the External Master of Engineering Program will now be presented. Points of significant departure from existing off-campus program mechanisms employed at other universities will be noted.

1. Program objectives - to provide additional design oriented engineering study beyond the four-year baccalaureate degree leading to the Master of Engineering degree. A further objective of this program is to allow engineers to pursue a graduate engineering degree regardless of their location within the state. The major thrust of the Master of Engineering Program (including the External delivery mechanism) is that of engineering design, based on a broad engineering, engineering science, and basic science foundation. The Clemson Master of Engineering Program is accredited at the advanced level by the Engineers' Council for Professional Development. A major difference between this program and most other operating external programs is that the Master of Engineering degree is in fact an engineering-design oriented program as opposed to the more typical research oriented Master of Science Degree curriculum. This program is designed to be of direct benefit to baccalaureate engineers in both near- and long-term periods.

2. Program Goals - the Master of Engineering Program prepares the engineer for: 1) a higher level of technical performance by increasing technical knowledge on a broad rather than a specialized basis; 2) a higher level of project leadership by increasing knowledge of economic evaluation, project planning, technical communication, and team management; and 3) a greater capability for self-study to keep pace with new developments in technology.

3. Program Delivery Mechanism - as indicated previously, the selected format for Master of Engineering courses is based on peer-group interaction using modern individualized instruction (guided self-study) techniques and occasional faculty student interactions. Audio tapes and visual information (photographs, slides, filmstrips) can be used by the instructor to reinforce particular aspects of the programmed text material. This permits the instructor to verbally and/or visually explain particular areas where he knows the student will have learning difficulties. In so doing, the instructor can ease the learning load on the student at critical points during a course.

   As indicated, the course delivery mechanism is individualized instruction based, as opposed to more formal "locked-step" lectures, closed-circuit TV presentations or the video cassette TV arrangement where students gather at a centralized location to view instructional material. Since most Clemson courses are developed using a guided self-study approach, individual students can develop a greater capacity for self-study which will assist them to maintain a higher technical level throughout their careers. Students receive materials on a regular, or an on-call, basis from the course director. Specifics on material distributions are provided to each student at the course organization session, which is the first session each semester for each course. At this session, course objectives and goals are outlined, peer-groups are established, and the course structure and delivery mechanism are presented and discussed.

   Peer-group reinforcement permits discussion groups to be established convenient to the student's home base. Each student can get together with other students on a periodic basis to discuss course difficulties and problem areas or share enlightenments gained during pursuit of the course. Quite often a problem encountered by one student can be resolved by other students in the group, thus permitting the student to progress at a reasonable rate without undue delay. If a problem persists, discussion with the course director is indicated. Peer-groups also assist individual students in maintaining a schedule sufficient to meet course milestones and deadlines. Additionally, the peer-group offers a social reinforcement to the individual by bringing together others in a common course who can share his concerns and problems in an interactive discussion mode. Peer-groups are normally composed of three to six individuals who meet regularly; peer-groups of two have been successful. A leader, chosen by the group, is responsible for keeping the group on schedule to meet deadlines set by the course director.

Periodic visits between the course director (Clemson Engineering faculty member) and the students serve to assess course difficulties, evaluate progress, and where appropriate, provide access to Clemson laboratories, library, or other learning materials. These visits do not necessarily involve an on-campus visit, but may include the program director visiting an off-campus site. Extensive use of telephone and mail contacts between students and the course director is used. Student groups often request regular weekly discussion meetings with faculty.

4. Program Admission Requirements - the Master of Engineering Program at Clemson University, including the external delivery mechanism, is open to individuals who have completed their baccalaureate degree in an Engineers' Council for Professional Development accredited program, or its equivalent, and who meet College of Engineering, departmental, and University graduate school admission requirements. There are approximately 120 students participating in the externally delivered Master of Engineering program at present; with about 40 students enrolled for the Fall Semester 1978-79. There have been three graduates who have exclusively used the externally delivered program in their graduate study efforts; four others expect to receive degrees in 1978-79.

5. Program Costs - the externally delivered Master of Engineering Program has been funded through regular College of Engineering course development funding with external students paying only regular on-campus graduate course tuition. Many of the same materials developed for off-campus delivery are also used for independent or individualized study courses taught on campus. No separate record of off-campus - on-campus cost splits is available. Suffice it to say that the students pay but a small portion of the total Program development and operation costs.

V. EXTERNAL COURSE MATERIAL FROM OTHER UNIVERSITIES.

The College of Engineering at Clemson University has carefully evaluated externally oriented material available from other universities in the United States. This search has been conducted to determine if materials are available which can be adapted to our program. Discussions with and, in certain cases, visits to Colleges of Engineering involved in external program development have been actively pursued. Clemson is availing itself of all available material which will help it to develop a quality external graduate engineering program.

At the present time, few other universities have been identified in the United States who are developing non-TV audio-visual based guided self-study programs at the graduate level for use in an external engineering program. Most other universities active in external graduate education use TV-based instruction. Successful TV-based programs serve areas of high engineering student densities.

Clemson University is therefore unique in its approach to graduate engineering education using individualized instruction techniques reinforced by audio-visual based material and peer-groups. Clemson's College of Engineering believes that the development of a program of this type could directly benefit all states where engineers are not concentrated in high densities. Even in those cases where engineers congregate in high densities, this mechanism can provide a significant increase in graduate education possibilities. This is especially true for individuals who must travel extensively and cannot avail themselves of available "locked-step" instruction. As illustrated in Figure 3, Clemson University, through its external graduate degree program, is truly a state-wide campus permitting engineers throughout the state to pursue graduate engineering education regardless of their location or concentration.

VI. PROGRAM COURSES.

Twenty-six externally delivered courses have been developed or are under development. These engineering practice oriented course subjects include microelectronics, computers, power systems, mechanical systems design, thermal systems, advanced HVAC, engineering economics, engineering reliability, safety engineering, and more.

Courses in the conceptual design stage include instrumentation and controls, microprocessor applications, energy systems (to include energy conservation and energy alternatives), and communication systems.

VII. FUTURE PROGRAM DIRECTIONS.

1. External Program Expansion and Student Enrollment Projections: The externally delivered Master of Engineering Program currently contains courses in electrical engineering, mechanical engineering, and systems engineering leading to degree options in electrical engineering and mechanical engineering. It is anticipated that enrollments will grow from a current level of about forty students to over 200 by the early 1980's. These projections are based entirely on enrollments in electrical engineering, mechanical engineering, and systems engineering courses and do not include the potential expansion of the program to include civil engineering courses. The Department of Civil Engineering at Clemson University is currently evaluating state-wide civil engineering interests in state-wide externally delivered civil engineering graduate level course work. The Civil Engineering Department has already initiated a program focused toward the Upper-Piedmont areas of South Carolina.

The externally delivered MENGR Program is directed by Dr. B. E. Gilliland, Professor of Electrical and Computer Engineering and Assistant to the Dean of Engineering. Degree program direction is the responsibility of Dr. E. H. Bishop for mechanical engineering and Dr. A. L. Duke for electrical engineering. Dr. E. L. Thomas supervises the systems engineering support. During the 1977-78 academic year, Visiting Alumni Professor Dean E. Griffith, on leave from The University of Texas at Austin, provided significant additional leadership.

The importance of this program to the State of South Carolina cannot be overstressed. Graduate engineering education improves the technological base of engineers, and provides increased engineering productivity and income potential for the engineers themselves. An advanced professional level of engineers can assist industry in improving processes and operations in the face of increased pressure from inflation, energy cost and foreign competition. Improved techniques for managing personnel and resources can provide opportunities to increase profits and/or lower costs. The increased incomes and profits of individuals and industries generate greater revenues for the State to meet its obligation to its citizens.

The externally delivered Master of Engineering program does further Clemson's public service endeavors by providing upward mobility and increased income for student practicing engineers. Through improved processes and operations, South Carolina provides stable employment for industries already located in the State. Enhanced education opportunities encourage new industries to locate in South Carolina.

The program's value may be summed up by comments from Guy White, one of three partners in a Columbia engineering firm and a professional engineer 20 years out of college. White says, "I had been going off and on to various schools, but the external program at Clemson was the only one with enough flexibility to allow me to work and to go to school at the same time."

VIII. PROGRAM EVALUATION

During 1977-1978, one of us (Professor Griffith) studied the extent to which Master of Engineering Degrees were being externally delivered in the United States, and reviewed the principal program characteristics of several externally delivered programs in engineering and the applied sciences.

This paper does not report on the many videocassette, instructional television, electrowriter, and/or teleconferencing systems used to deliver regular or "locked-step" campus educational programs to practicing engineers distributed geographically. Those programs have been reported extensively in the literature.

The focus of these studies was to determine which United States engineering colleges and schools were using a personalized, or individualized, system of instruction format to address the special needs of practicing engineers for off-campus, or external, credit courses in accredited programs leading to recognized degrees.

IX. UNITED STATES ACCREDITED EXTERNAL PROGRAMS IN ENGINEERING/APPLIED SCIENCE.

An examination of all 25 engineering colleges and schools with advanced level Programs accredited by the Engineers' Council for Professional Development as of October 1976, identified only one institution, Clemson University, as having an essentially external delivery mechanism.

A review of other institutions listed by the National University Extension Association in the 1976 publication "On-Campus/Off-Campus Degree Programs for Part-Time Students" revealed only externally delivered Programs in engineering that were transmissions of on-campus courses or off-campus lecture courses.

An examination of the document, Adult and Part-Time Students and the CIC Universities, a 1977 Publication of the University of Iowa Division of Continuing Education, led to a rediscovery of the University of Iowa "Guided Self-Study Program of Advanced Study for the Practicing Engineer." This Program began around 1964 with a grant from a private foundation, and has produced over 35 Master of Science degree graduates. The students can earn the degree entirely through Guided Self-Study using special materials covering topics identical to on-campus courses.

Later, through the National Science Foundation grants list, the University of Alaska External Degree Programs in Geology and Geophysics were discovered. These Programs, started in 1973, had 15 students actively pursuing degrees as of Fall, 1977, and were expected to produce one graduate per year beginning in Spring 1978.

Empire State College of New York University offers undergraduate programs as 'open university' type studies of professional development fields, but does not offer accredited graduate level programs in engineering.

A list of Colleges and Schools provided by the American Council of Education 'Study of External Degrees' did not reveal any institutions offering programs totally personalized or individualized for practicing engineers.

A review of the "Off-Campus Degree Programs" listed in The Catalog, published by Professor B. E. Lauer of Boulder, Colorado, similarly did not reveal any new engineering colleges or schools with off-campus masters level personalized study programs for practicing engineers.

This search for similar Programs has led to the conclusion that the Clemson Program is essentially unique or has, at most, some similarities to the University of Iowa Guided Self-Study Program. Because of the readily available Clemson University data, the conclusions drawn are taken primarily from studies of the Clemson Program, and especially, from student surveys. The University of Iowa Program has been described elsewhere by Professor Thomas Farrel. The resulting experiences are comparable.

X. GENERAL PROGRAM CHARACTERISTICS: THE EXTERNAL STUDENT BODY.

Attempts were made to survey every external student enrolled in Clemson's program from its inception through May 1978. Numerous external students could not be reached because they had left the state for personal or professional reasons. The following conclusions are drawn from the available returns of written questionnaires and/or telephone conversations with external students.

The Clemson externally delivered Program for Practicing Engineers attracts a very heterogeneous student body, one which during 1977-1978 ranged from 24 to 54 years of age with a mean of 33.8 and a median of 32+.

External students certainly vary in academic background. The grade points of student applicants also range widely from just over 2.0 (the usual minimum acceptable for the baccalaurate) to 4.0 (the maximum possible) with an average around 2.8. Some of the older students have not taken any new courses introduced during the past 10 to 20 years. All students have been subjected to the forgetting curve, their academic knowledge decaying with time while their specific job skills gain strength through reinforcement due to regular use.

External students are primarily motivated to enroll in these programs by the pressures of their technical work and rarely by other persons. External students expect to gain breadth of technical understanding and technical confidence more than any other benefit from external programs. This may reflect the program design rather than general need. External students do not perceive of most short courses and training institutes providing engineers with the depth of understanding necessary to demonstrate competency in the subjects studied. External students want useful skills and knowledge which persist. Clemson's external students, who study, mostly after work, 12-16 hours per week/three hour course, do want recognition (in the form of a degree) for the effort required [illegible] intensive learning at an advanced level [illegible] Continuing Education Unit and the Professional Development Degree have not yet been widely established or recognized by the engineering profession as a transferable or negotiable currency of competency. The Master of Engineering Degree is conversely seen by Clemson external students as a University-backed recognition of status. External students demand and require a progressive sequence of course offerings to reach both personal development and degree goals.

External students are extremely pragmatic, as compared to undergraduate engineering students and many graduate engineering students. External students require subject matter relevant to their (student) goals and jobs in order to maintain their motivation. If external courses do not deliver content relevant to student jobs, the external students vote with their feet, dropping out of the Program.

Any external Program addressing the needs of practicing engineers must recognize the wide variation of individual differences, individual motivations, and individual priorities that require a personalized approach to guided studies.

XI. PROGRAM DESIGN FEATURES: ANDRAGOGIC FACULTY AS THE CRITICAL FACTOR.

The essential features, as discussed previously, designed into successful external programs, are special instructional modules, peer group reinforcement, and a new mentorship role for the faculty, the latter being a peer learning relationship between student and faculty member, something seldom possible or attempted with most on-campus students.

Faculty are the critical ingredients to the success of an advanced level engineering external degree program. Faculty who cannot convert from pedagogic to andragogic teaching styles should not be placed in the uncompromizing position of advocating, as a learning helper, self-study when they prefer, and only know how, to "perform." Many faculty have neither the practical experience nor the humility to help practicing engineers learn; these faculty would rather tell engineers what they should know. Such academic arrogance has resulted in a general credibility gap in University external and extension programs throughout the United States. Faculty who cannot make the transition to the new mentorship role should not be forced to participate; they should be replaced with other faculty who are empathetic to the needs of practicing engineers and desire to effectively address those needs.

XII: CLOSURE.

Clemson's pioneering externally delivered Program has laid the ground work for other Universities to address the needs of isolated practicing engineers everywhere. The successful expansion of the Clemson external delivery approach now depends on the vision and energy of continuing professional development leaders everywhere. The "it can't be done" excuse is no longer acceptable; Clemson is doing it!

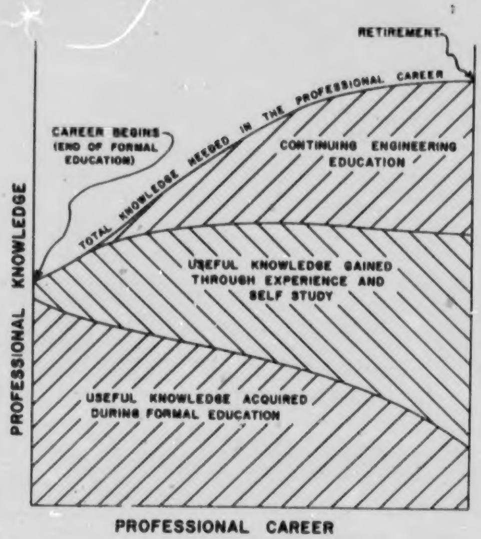
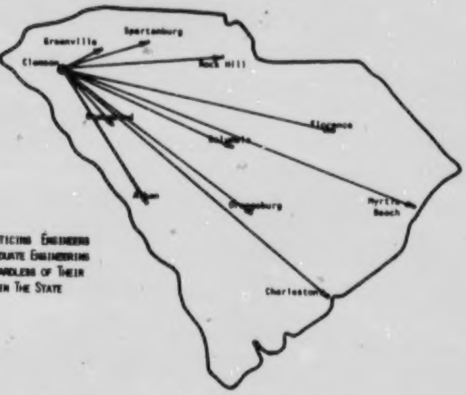


FIGURE 1

STATEWIDE CAMPUS

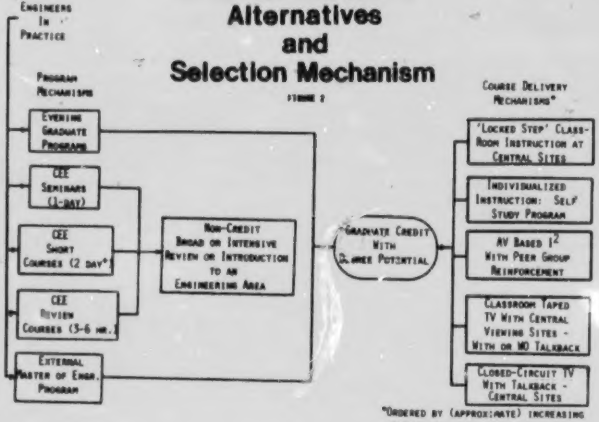
FIGURE 3


Greenville
Spartanburg
Clemson
Rock Hill
Florence
Columbia
Aiken
Orangeburg
Myrtle Beach
Charleston

PERMITS PRACTICING ENGINEERS TO PURSUE GRADUATE ENGINEERING EDUCATION REGARDLESS OF THEIR LOCATION WITHIN THE STATE

External Education Alternatives and Selection Mechanism

FIGURE 2


ENGINEERS IN PRACTICE
PROGRAM MECHANISMS
EVENING GRADUATE PROGRAMS
CEE SEMINARS (1-DAY)
CEE SHORT COURSES (2 DAY+)
CEE REVIEW COURSES (3-6 MR.)
EXTERNAL MASTER OF ENGR. PROGRAM
NON-CREDIT BROAD OR INTENSIVE REVIEW OR INTRODUCTION TO AN ENGINEERING AREA
GRADUATE CREDIT WITH DEGREE POTENTIAL
COURSE DELIVERY MECHANISMS*
'LOCKED STEP' CLASS-ROOM INSTRUCTION AT CENTRAL SITES
INDIVIDUALIZED INSTRUCTION: SELF STUDY PROGRAM
AV BASED I² WITH PEER GROUP REINFORCEMENT
CLASSROOM TAPED TV WITH CENTRAL VIEWING SITES - WITH OR NO TALKBACK
CLOSED-CIRCUIT TV WITH TALKBACK - CENTRAL SITES

*ORDERED BY (APPROXIMATE) INCREASING COST PER MODULE

DEAN E. GRIFFITH

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A CONTINUING EDUCATION PROGRAM FOR PROCESS INDUSTRIES IN FRANCE AND MEDITERRANEAN COUNTRIES

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The objective evaluation of Continuing Education (C.E.) is most important and should provide employers and employees with the evidence of its being profitably justified.

In previous publications[1,2] we have developped a comprehensive modelling of the human brain, and evaluated the balance of knowledge resulting from a compromise between the "feeding" process (learning rate) and the "loosing" processes (forgetting rate, senescence of brain, obsolescence of knowledge...). We have shown how the increase of "proficiency" acquired by a practising engineer following a C.E. course, is positively influenced by his specialisation and motivation in the taught topics. We have also pointed out that an adequate planning of C.E. must be adapted to each type of information : catalogue-type knowledge, methodology knowledge, technical know-how.

Besides such a research program devoted to the profitability of C.E. in terms of knowledge balance, the present contribution, based on our own experience, is mainly concerned with the analysis of characteristic features and cost balance of two continuing education organisations.

1. IMPORTANCE OF CONTINUING EDUCATION IN FRANCE

11. The law of July 1971

The Continuing Education of engineers has always been in France a subject of paramount importance. An interprofessional agreement was signed, in 1970, between the National Council of Employers (CNPF) and the Labor Unions. Later, the french government established a law (July 1971) giving the general regulations for organizing continuing education for *all* employers in *all* the private companies. The importance of this law is illustrated by the compulsory financial contribution : the law obliges each company to allocate for continuing education *1.1 % of the wage bill* in 1978, (this expense is tax-deducible).

An overall survey, made at that time, revealed that the *biggest* french chemical and petrochemical companies already spent an average of 2 to 4 % of the wage bill for continuing education. Therefore the french law did not implied an extra-expense for these big companies, but it has been doing so for a great number of *small* chemical firms, and also for the majority of food industries and agricultural industries.

The survey furthermore revealed that the greatest part of the continuing education already carried out was given to *engineers* (or to University graduates of the same level). A small part of the budget was devoted to the education of techniciens, and almost nothing to foremen and to workers. In the last six years great efforts have been made to develop the C.E. of these employers.

12. Some results of three surveys

Three surveys made in France by the FASFID (*) in 1971-74 and 77 among a little more than 100 000 engineers from all disciplines gave the following results :

- the number of answers received was 16 000, 28 000 and 23 000 respectively
- a constant fraction (i.e. 44 %) declared that they did not attend any continuing education course during the preceeding period of three years
- Figure 1 gives the distribution of numbers of engineers who declared a given number of days of C.E. courses : between 1 and 9 days, between 10 and 19, between 20 and 29 days, etc... It can be seen that the three distributions are very similar : this conclusion is quantitatively confirmed by the mean value, calculated from each distribution. We thus obtained, for the positive answers only :

23.4 days during the 3 years : 1968, 1969, 1970
22.5 days during the 3 years : 1971; 1972, 1973
24.25 days during the 3 years : 1974, 1975,1976

The three mean values are practically equal.

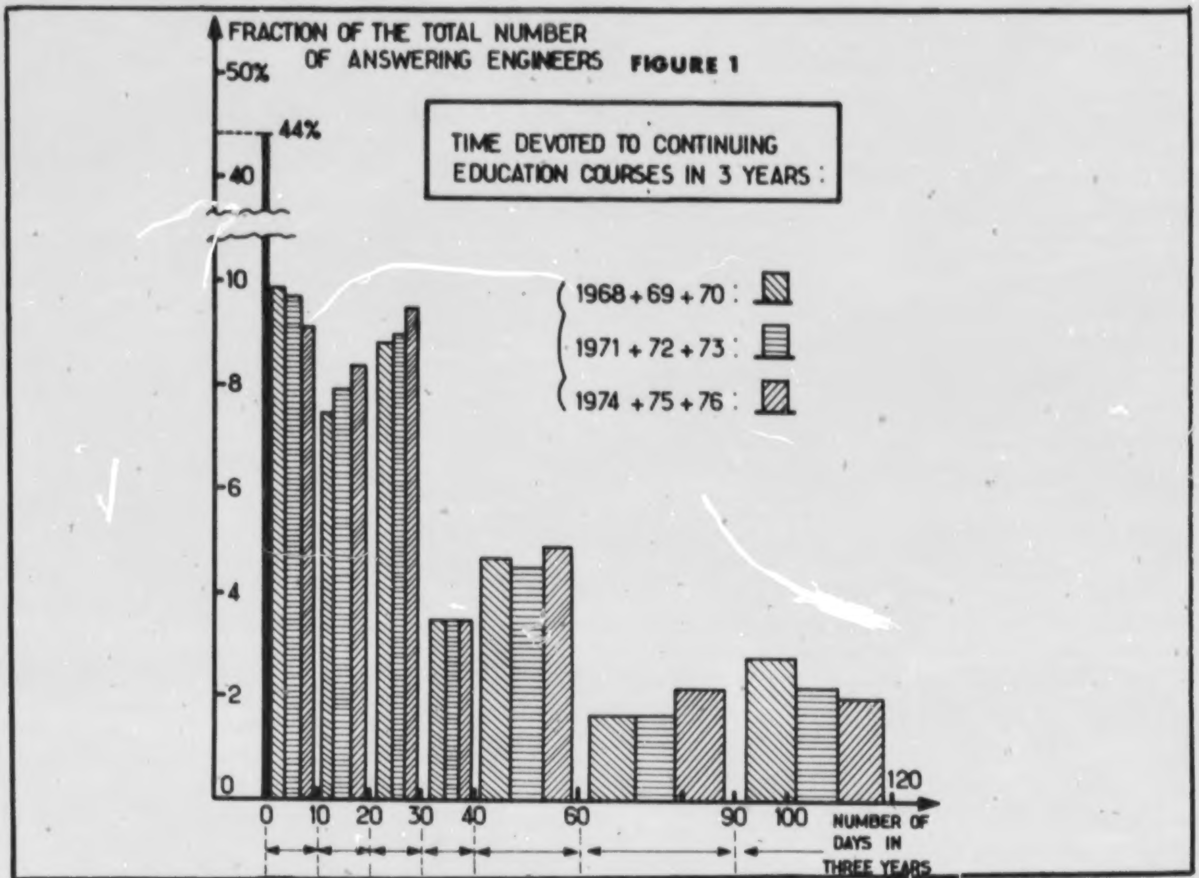

FIGURE 1

We can surprisingly conclude that the time devoted to C.E. by each engineer, was exactly the same before and after the date of application (1972) of the law. However it was observed (see next paragraph) that the origin of the engineers has changed involving a shift towards a greater number of them working in small and middle size chemical, food and agricultural industries.

We finally reach the conclusion that during the last ten years, each engineer has, on the average, spent *4.4 days per year in C.E. courses*. We must however not forget that such an average value comes from a *very wide* distribution, since it includes 44 % of negative answers (no course) but also 4 % of engineers having followed courses between 60 and 120 days in 3 years.

Figure 2 gives the distribution of ages of engineers who followed C.E. courses, according to the recent FASFID survey. It is interesting to observe that C.E. is widely spread over the whole professional life : the fraction of engineers who use to follow C.E. courses in the first 8 years after leaving university, is very important (50 % of the engineers younger than 30). On the other hand, up to 55 years old, this fraction is still 50 %.

Let us now present, as a living illustration, the activities and the administrative framework of one Continuing Education Organization in the field of Chemical and Process Engineering, the *Centre de Perfectionnement des Industries Chimiques* (CPIC) operating mainly in Nancy (France), and also in a number of mediterranean countries.

2. THE CPIC, a FRENCH CONTINUING EDUCATION ORGANISATION FOR THE PROCESS INDUSTRIES

21. Administrative framework

The University of Technology at Nancy, called INPL (*), is composed of five Engineering Schools. One of these schools, called ENSIC (*), "produces" each year about 50 graduate chemical Engineers. The "CPIC" operates since 1960 as a *non-profit private Foundation*, administratively *independent* from ENSIC, but located in the same building and strongly connected with it, in many scientific activities.

The CPIC is directed by a board of administrators composed of 80 % of practising engineers, representatives from industry and by a scientific council composed of each university member (or engineer) responsible of each C.E. session. The managing Directors are two University Members.

22. Objectives

The objective of the CPIC is to organize continuing education courses for practising engineers and scientists of the chemical and process industries.

In 1977 the CPIC organized 2940 "man-days" courses, under the form of 24 courses in France (and 4 courses abroad) each during five days, for a total of 600 individual persons. The mean attendance was thus of 22 persons per course. In 1978 and in 1979, the CPIC will organize 39 courses in basic sciences and techniques, in unit operations of Chemical Engineering and in Development, Economics and Environment as presented in Table 1.

The distribution of ages of attendants to the CPIC courses is a little "younger" than that given by the FASFID survey for the whole of C.E. courses in France : only 22 % of engineers are older than 40 years, as compared to 38 % (which can be deduced from figure 2). This difference comes from the fact that a number of such engineers are company-managers and thus prefer to attend C.E. courses in management, marketing..., and other non-technical topics.

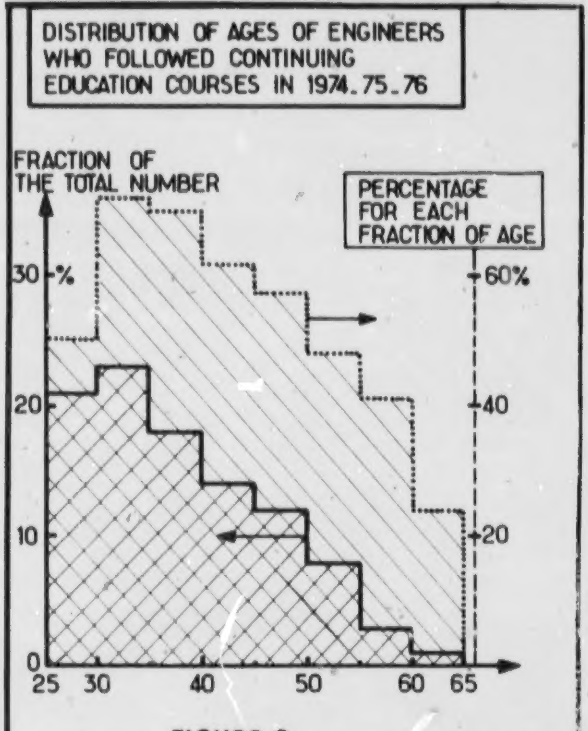

FIGURE 2

Another interesting point concerns the size of the firms where the engineers are coming from. For quite the same number of attendants (≃ 500) in 1971 and 1977 ; 20 % were employed in small and middle size firms in 1971, while the percentage is 30 % in 1977.

As for the jobs of engineers, they are as follows, in 1976 :

Research laboratories	30 %
Pilot plants and development	37 %
Process, maintenance and control	27 %
Application and trading	6 %

TABLE 1 - CPIC COURSES FOR 1979

BASIC SCIENCES AND TECHNIQUES

1. Methods of chemical engineering
2. Chemical reaction engineering
3. Fluid mechanics for chemical engineers
4. Basic modern organic chemistry
5. Bases of macromolecular chemistry
6. Bases of "chimiometry"
7. Thermodynamics and data bank for chemical processes
8. Chemical kinetics : concepts and methodology
9. Photophysics and photochemistry - Radiating energy
10. Techniques for the study of solid surfaces
11. Basic spectroscopy analysis
12. Optimization techniques
13. Modern techniques for the utilization of computers
14. Scientific methods and economics in chemical engineering (in english)

UNIT OPERATIONS OF CHEMICAL ENGINEERING

15. Distillation
16. Modern applications of fluidization
17. Techniques of drying
18. Techniques of liquid-liquid extraction
19. Gas-liquid reactors and absorbers
20. Ion exchange
21. Industrial crystallization
22. Filtration of liquids
23. Vaporization and condensation
24. Fixed bed catalytic reactors
25. Industrial catalysts
26. Electrochemical engineering
27. Biochemical engineering

DEVELOPMENT - ECONOMICS AND ENVIRONMENT

28. Economic evaluation of projects
29. Process development
30. Economy of raw materials
31. Industrial energetics : 1st part : Thermodynamics and mechanics of energy conservation
32. Industrial energetics : 2nd part : Economic optimization and choice of investments
33. Optimization and production management (in french and in english)
34. Process control and automatization
35. Prevention of air pollution
36. Prevention of water pollution
37. Chemical and environment
38. From crude oil to polymer materials : the petrochemical industries (in english)
39. Energy saving in process industries (in french and in english)

23. Costs

231. For the CPIC.

The cost of one 5 days course (totalling 30 hours of lectures and exercises) organized in Nancy for a constant number of 22 participants is given in "current" french francs on Figure 3.

It increased from 31 600 F in 1973, to 51 000 F in 1977.

Taking the inflation into account, gives a new curve showing a quite constant value of 48 000 ± 3 000 F (**).

Table 2 gives the itemized break-down of the cost of such a five-days course, in 1977 :

TABLE 2

- Salaries of the permanent employers (6 persons)		29 %	85 %
- Stipends to the lecturers	27 %	34 %	
. Travel and accomodation expenses for lecturers from outside	7 %		
- Overhead costs		8 %	
- Miscellaneous expenses		3 %	
- Operating costs independent of the number of participants		11 %	
- Operating costs proportional to the number of participants per course		15 %	
		100 %	

We have observed that all along the last 5 years, the above fractions of the total cost remained quite constant.

It must be pointed out that the fraction pertaining to documentation, mailing, etc..., which is proportional to the number of participants, is only 15 % of the total cost. As a consequence, a session with 40 participants (maximum acceptable from our point of view) does not cost much more than one with 22 participants : 57 260 F instead of 51 000 in 1977. Similarly, a session with 10 participants (minimum presently accepted) would also cost : 46 830 F !

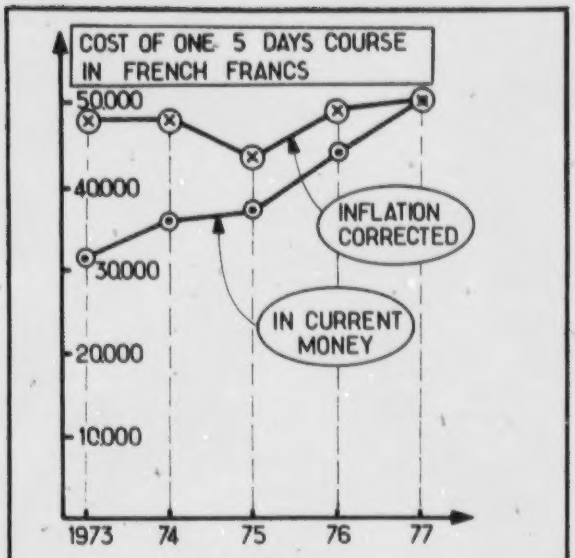

FIGURE 3

232. For the employer

Since the CPIC is a *non-profit* organization, the previous cost is quite equal to the *sum* of the fees required from each applicant. The fees required in 1977 were *2 320 F per applicant* (assuming an average number of 22 participants). These fees only covers the right to attend the lectures, to participate in all tutorial exercises, round-table discussions, visits of industrial plants (eventually) and mainly to receive an abondant documentation grouping the texts of all lectures and complete written solutions of exercises. The fees exclude any expenditure for travelling accomodation, etc...

It may be interesting to assess the financial budget of such a five-days C.E. course, from the *point of view of the employer :*

Expenditure in 1977 :	- fees to the CPIC	= 2320 F	3650 F
	- accomodation in Nancy and travelling from another french city	= 1330 F	
	- salary of the engineer during 5 days	= 2500 F	3750 F
	- social charges and taxes (≈ 50 % of the salary)	1250 F	
	TOTAL		7400 F

Let us recall that according to the 1971 law, the employer *must* devote to C.E. 1.1 % of the wage bill. If applied to the particular case of this engineer, 1.1 % of his annual total salary is equal to :

$$\frac{1.1}{100}\,(52 \times 3\,750\ \text{F}) \simeq 2\,745\ \text{F}$$

It can thus be concluded that such an expenditure, for *one* five-days C.E. course *per year*, would represent *1.87 %* of the annual salary of the engineer, when counting only the fees and travelling + accomodation expenses. It would reach 3.7 % of the an-

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(**) Footnote : it must be mentioned that during the same period, the prices of materials (mainly that of paper) have increased by a factor 1.8 and the salaries by a factor 1.35. The increase of "productivity" of the CPIC has thus exactly compensated the increase of the life cost.

nual salary, if we add the salary itself during these five days.

24. International activities of the CPIC

Two types of international activities are presently developped by the CPIC :

- *Engineers from abroad participate to sessions in France*

During the last three years, 15 to 17 % of participants came from abroad, mainly from european french speaking countries (Belgium, Switzerland) and also from Spain and Italy.

When coming from further countries, applicants use to stay longer than one week in Nancy, attending a number of sessions and participating, during the intervals, in one of the research programmes of our Chemical Engineering Laboratories.

- *C.E. courses are given in foreign countries*

The CPIC usually prefers to avoid organizing C.E. courses directly in a foreign country and operates in association with an organization belonging to the concerned country, for example a public agency, a technical university or a private foundation similar to the CPIC itself. As an example, the cooperation with the "Arab Continuing Education Centre" in Cairo, Egypt, is described in the following paragraph.

Another typical association has been created with the "Universidade Nova de Lisboa" (Portugal). Professor GANHO, from this university, organizes each year, a session on "Energy savings in process industries". The lectures, tutorial exercises and round table discussions are given by 3 University members from Nancy and 2 practising engineers coming from french private companies. Additionally two portuguese engineers gave lectures on the applications to their peculiar cases.

3. THE ACEC, AN EGYPTIAN CONTINUING EDUCATION ORGANIZATION FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

The Arab Continuing Education Centre in Cairo began its activites in 1977, on basis of an entirely private initiative, with two courses in english language selected from the repertoire of the CPIC. The original idea was to create a subsidiary of the CPIC which would take care of extending its educational activities to the Arab World. After the most encouraging success of both courses organized in 1977, several educational bodies in the U.K., the F. R. of Germany and the U.S.A. were contacted and a more varied list of topics could be offered by the ACEC for implementation in Egypt (Table 3 gives an up-to-date listing of topics covered by courses offered by the ACEC). In 1978, seven courses could be delivered and the number should exceed ten in 1979.

31. Organizational aspects and objectives of the ACEC

The ACEC is an independent private organization established in Cairo (Egypt) and directed by its Managing Director who is assisted by extraneous office facilities and services.

TABLE 3 - ACEC COURSES FOR 1979

A - GENERAL METHODS AND TECHNIQUES

1. Scientific methods and economics in chemical engineering

B - ECONOMICS AND MANAGEMENT

2. Engineering project management
3. Maintenance management
4. Project evaluation, planning and control
5. Optimization and production management
6. Modern production management
7. Planning and layout of industrial plants
8. Planning and layout of warehouses and materials handling systems
9. Inventory control and material requirements planning

C - TECHNOLOGY, OPERATION AND MAINTENANCE

10. Quality control
11. Process instrumentation and control
12. Industrial computer sciences : utilization of mini- and micro-computers in process control
13. From crude oil to polymer materials : the petrochemical industries
14. Rigging, hoisting and lifting techniques for the construction of chemical and petrochemical plants
15. Heavy diesel engines - maintenance and operation

D - PETROLEUM GEOLOGY AND ENGINEERING

16. Gas technology
17. Drilling engineering
18. Offshore operations
19. Advanced petroleum geology
20. Oil and gas well completion
21. Prevention and control of oil and gas well blowouts

The Petroleum industry in Egypt and the Arab World being relatively more organized, progressive and "wealthy", if compared with other industries, is the main customer (and the only one to-date) for continuing education activities. All ACEC courses were thus contracted by and for the EGPC (Egyptian General Petroleum Corporation), attendance from other countries (Kuwait) being so far exceptional. The selection of topics is carried out jointly with the technical and training staff members of the EGPC, enrolment of participants (not exceeding 25 per course) being entirely left to the EGPC and its companies.

32. Costs and financing

A five-days course delivered in Egypt by a foreign organization cooperating with the ACEC costs, in average, 15,000.00 U.S. Dollars. The cost increment over and above rates applicable in the country of origin (e.g. France for the CPIC) is, basically, due to the travelling, accomodation, per diem expenses of the foreign instructors, the freight charges of manuals, literature and educational aids and finally the ACEC running and overheads expenditure.

The employer (an industrial organization) established in Egypt who would adopt an educational trend of one "imported" five-days course for each employed engineer per year and assuming an average monthly salary equivalent to 500.00 U.S. Dollars for an engineer (including social charges and taxes), has, therefore, to allocate a budget containing 15 % of the wage bill for implementing continuing education. This explains the scepticism of many employers concerning the economic aspects of continuing education and their reluctance to adopt such an educational trend to enhance the "proficiency" of their employees.

4. CONCLUSION

Concluding in brief, we may state that the introduction and development of continuing education for the process industries in France and other mediterranean countries, within the framework of the CPIC and its affiliated organizations, has been successful often beyond expectations.

In developing countries (Egypt), however, the implementation of high standard up-to-date specialized technical courses is only possible, on a large scale, if it is subsidized by international organizations concerned with technical education and industrial development (UNESCO, UNIDO, CAPEC), bodies offering development assistance (AID) or the local Government, until such countries become technologically self sustained and can depend on their own resources of specialized technical trainers and instructors.

ABBREVIATIONS (*)

FASFID : Fédération des Associations et Sociétés Françaises d'Ingénieurs Diplômés
INPL : Institut National Polytechnique de Lorraine
ENSIC : Ecole Nationale Supérieure des Industries Chimiques
CPIC : Centre de Perfectionnement des Industries Chimiques
ACEC : Arab Continuing Education Centre for the Petroleum and Chemical Industries
EGPC : Egyptian General Petroleum Corporation

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Proceedings of the First World Congress on Chemical Engineering, Amsterdam, June 1976 - Elsevier, pp. 459-478.
(2) M. SALLALY : "Adequate continuing education planning for engineers"
Communication to the International Symposium on the Continuing Education of Engineers, Baghdad, Nov. 27-30, 1977.

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- Chairman of the Committee "Energie et Génie Chimique" at D.G.R.S.T. (Ministry of industry) dealing with Energetics of industrial processes.
- Is author or co-author of 250 original scientific publications since 1948.
- Chevalier de la Légion d'Honneur.

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POWER ENGINEERING PROGRAMS IN THE USSR

Dr. Victor Bespalov
Moscow Power Engineering Institute
USSR

COMPUTERIZED ACCESS TO ENGINEERING INFORMATION

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In her present position at Ei, Mrs. Hardy is responsible for Ei's education program (including conducting user workshops and developing educational materials), serves as a liaison for user queries, and is responsible for public relations, including the corporate newsletter.

SESSION 7

NATIONAL NEEDS ANALYSIS FOR CONTINUING ENGINEERING EDUCATION

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DEVELOPING A NATIONAL NEED ANALYSIS

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Summary

Continuing education has been a relatively familiar part of the total educational pattern for many generations in a good number of countries around the world. More recently it has concerned itself as well to the encouragement of lifelong learning and nontraditional approaches. This has brought about a new emphasis upon placing the individual student at the core of institutional concern.

This new dimension, whether in engineering or any other discipline, mandates an analysis of prospective student needs and characteristics. It also calls for an analysis of how well prepared an educational institution is to satisfy such needs. Surveys of students and institutions are a prerequisite, therefore, if there is to be fulfillment of expectations by the former and provision of appropriate methods, tools, delivery systems, and forms of recognition by the latter.

Two differing surveys are described below, one directing specific questions to students, the other to institutions. Both are necessary for a proper assessment of needs and for intelligent and effective planning. Specific knowledge should be sought about a large number of factors that will govern such planning.

Continuing education, in spite of being an obvious resource, has all too often been hampered by rigid definitions of purpose, conventional structures, peripheral and half-hearted acceptance, unnatural budgetary problems, and too much separation from the basic educational program. It has its greatest opportunity now to break out of this mold. With more flexible attitudes and the use of many new tools available, it can place itself squarely in the mainstream of the educational process.

I.

It is certainly unnecessary to remind a group such as is gathered here that the idea of continuing education has been with us for centuries. Particularly is this true during the past century, not only in the United States but in many other countries as well. It has shown itself in many forms and been identified under many rubrics.

Unfortunately, perhaps even mysteriously, the term "continuing education" has rarely prompted a feeling of excitement or adventurous educational exploration. There seems to be no magic or music in it. Perhaps this is because those who are its champions prefer it that way.

Occasionally, in talking about this term, I have used the illustration of Mark Twain, one of our outstanding American authors, and his experience with the telephone. In addition to being a great and colorful writer, Twain was an inveterate buyer of new gadgets and one of the first telephone subscribers in Hartford, Connecticut.

You can well imagine that the quality of telephone service in those days did little to help anyone control his temper and thus to discourage profanity. Mark Twain, over the years, had developed a magnificent repertoire gathered from those most eloquent of cursers, the Mississippi steamboat pilots. But he had somehow managed to conceal this talent from Mrs. Twain.

On one occasion when he was particularly exasperated by the failure of the telephone, Twain burned the wires with his richest and most searing invective. Hanging up with a great flourish, he turned and to his surprise and discomfiture saw his wife standing in the doorway, cold, aloof, outraged.

Perhaps Mrs. Twain had been taught by her mother that the way to cure a husband of using profanity was to join him in the practice so that he would realize how horrible it sounded. At any rate, whatever her reason, in rather halting but unmistakable words she repeated his telephone comments verbatim.

Mark Twain listened and then looked at his wife for a long time, admiringly, but shaking his head from side to side in regret. And then he said, "My dear, you have all the words, but none of the music."

In the past few decades two additional terms or labels have received increasing attention. One is "lifelong learning" and the other, "nontraditional study." Whether they will bring magic or music is too early to tell. Both relate closely and naturally to continuing education. Lifelong learning, championed in theory for decades or even centuries as an educational concept, has now been recognized as a major goal in the United States through the passage of the Mondale Act in Congress. I need not remind this audience of its many models in other countries and the success of programs like the Danish Folk Schools. Similarly, the amendments by the United States Congress to the Education Act of 1972 concentrate heavily on the need to develop and support nontraditional approaches to learning. The UNESCO International Commission on the Development of Education, reporting in 1972 after a world-wide examination of educational practices, came to the same conclusion with considerable emphasis on the attention to be given to the individual learner.

The significance of these and other national or international actions is, however, more than the simple reiteration of a belief in and a commitment to continuing education. A new dimension has now appeared not only in official documents but in the characteristics of programs recognized or stimulated by these documents. You have been devoting the major portion of this conference to examining such characteristics, and it remains for me as best I can briefly to show how broad is the concept that lies behind them and to point to the responsibility this adds to your planning activities.

The new dimension of which I speak is that of placing the student, whatever his or her age and circumstances of life, at the core of institutional concern. It represents the cultivation of an attitude that puts the student first and the institution second. It concentrates on the student's need rather than the institution's convenience. It encourages diversity of individual opportunity rather than uniform prescription. It deemphasizes time, space, and even course requirements in favor of proven competence. It is a process that tries to include as many learners as can benefit rather than to exclude.

Adding such a dimension as a way of opening doors or otherwise removing obstacles to learners calls for two major analyses, one relating to the needs of the individual learner, the other to the resources of the institutions. In both instances information is necessary that ultimately shows all we need to know about the students themselves and the ability of institutions to match student needs with institutional resources. In broad terms the analyses, both of student and institution, should tell us the following as a basis for planning:

1. The degree of understanding of the conconcepts underlying continuing education and the concomitant degree of commitment to these concepts.

2. The opportunities for easy access to learning and the obstacles to that access presently existing.

3. The means or methodologies or delivery systems most practical and most available.

4. The various program models for learning most acceptable to students and most available within institutions.

5. The forms of recognition of achievement being sought and the institutional forms of credit that are possible.

6. The practical considerations of financing, both for the individual student and the institution.

Studies that include the type of information I have just outlined are essential to an intelligent and prudent planning process. They can be undertaken nationally, regionally, even locally, and indeed they have been. There are a number of examples that could be cited. In the interests of the time allotted, I shall describe just one in considerable detail, one which I helped to bring about and therefore familiar to me.

II.

From 1971 to 1973 I had the privilege of serving as chairman of the Commission on Non-Traditional Study, a national group of twenty-six men and women from different walks of life, and sponsored by the Carnegie Corporation of New York (which is a private foundation), the Educational Testing Service, and the College Entrance Examination Board. This two-year study concentrated on a study of nontraditional education "in its concepts, its performance, its promise, and its dangers."[1] The Commission's findings were reported in a volume titled Diversity by Design[2] and even more details were provided in three other books which you will find listed in the bibliography of this paper.[3]

Among the tasks the Commission set for itself at its very first meeting was one "to identify the inadequacies in current data necessary for intelligent decision making and to press for correction of such inadequacies."[4] As a first major step in this task, the Commission brought into being a national survey which would provide the basic data prerequisite and essential to any analysis and recommendations for action. Appendix A of the Commission's book, Planning Non-Traditional Programs,[5] offers the format, questions, and results of a "survey of adult learning" obtained by a sampling of adults throughout the nation. Appendix B of the same book[6] presents an "inventory of institutional resources" which similarly shows the format, questions, and results in a canvass of more than two thousand institutions of higher learning in the United States. It may be helpful if I describe these surveys more fully.

If you in the engineering field were to approach a national or regional or even local needs analysis in the same way, you would obviously make adaptations in the questions to be asked and the basis for your sample would be different. But the purpose and style could be quite similar. For example, the first section of the Commission's survey began by asking for a first choice of an area of study. Forty-nine different areas were listed, of which engineering was only one. You, on the other hand, would need to list only the different classifications of engineering which prospective students might be interested in pursuing for continuing study. But other questions regarding areas of study are bound to be quite similar. For example, we endeavored to discover whether students wanted credit or non-credit courses, what methods of study they preferred, where and when it was convenient for them to study, how much time they could make available, how long they planned to continue, the reasons they had for wanting to learn more than they already knew, the degree of their willingness to pay for instruction, what obstacles stood in their way, what relationship to an institution they expected, and what their counseling needs were.

You would also, as we did, want to know the current situation of prospective students. How much formal education do they already have? What kind of degrees, if any, do they seek? What have they been doing during the previous twelve months to achieve their goals? And you would want certain other background information: what reasons did they have for not taking courses before? What is their sex, age, race, marital and family status? What is their income? What kinds of employment are they engaged in currently?

One word of caution should be given about interpreting the results of such a survey. What adult students say they want to do and what they actually do thereafter are often two different things. General experience with surveys of the type I have described shows that enrolment will rarely be more than two percent of those who originally expressed a desire to enroll. In the case of a specialized group such as yours, where I would assume the student motivation to be much stronger, the percentage of enrolment should be higher. But even then the percentage will be comparatively low. I remember very vividly that when I was Chancellor of the University of California at Santa Barbara we surveyed employees of electronic and engineering industries in an industrial park almost adjacent to the University. We asked then what courses they wished to have, available hours, and all the rest. The enrolment that followed was not even close to the estimate we might have expected according to the survey. Part of the reason for such a variation can be attributed to human nature, of course. But a good part of the loss can be from the lack of promotional activity by the institution once the survey has been taken or the lack of skill with which promotion or marketing techniques are used. Another key factor can be the degree of enthusiasm displayed by the corporate leadership of the industries involved. These are valuable lessons of success and failure to be learned from the past, and they should be carefully studied.

Surveying student needs is of little value unless it is accompanied by an inventory and analysis of institutional resources. Indeed, doing the first without the other can be a dangerous and defeating exercise. It whets the appetites of prospective students, stirs and heightens their aspirations, and creates expectations that will not necessarily be met. Students can be turned off quickly and permanently when they find that what they have been led to hope for is, in fact, unavailable. When this happens, a severe blow is dealt to continuing education. This constitutes an institutional insensitivity that can create a personal tragedy as well. Both can be avoided if the inventory precedes the survey and includes not only the quantitative aspects of the institution's resources but clear indications as to the degree of interest it has in adult students and how it views continuing education generally.

The inventory, therefore, should concentrate first of all on the extent to which continuing education courses or programs are being offered and the characteristics of such courses or programs. The emphases should be on those aspects that show the willingness of the institution to design unconventional programs for unconventional adult students. How much interest or concern is there, for example, for the working adult who cannot easily come to the campus or cannot devote full time to classroom work? What other locations for learning experience -- such as regional center offerings, field work, home study, or other off-campus programs -- can be provided? What non-lecture or non-classroom teaching and learning methods are considered valid by the institution and are being used? A list of these should be available with some explanation of what makes them especially suitable to the adult learner. Specific information is also valuable as to the degree level of the program, its length, focus, the principal location where it is offered, the types of student for whom it is designed, the number of years it has been in operation, its current enrolment, and its planned enrolment.

The policies and practices of the institution are also of relevance in assessing actual or potential resources. It is through an analysis of these that one can determine the degree of its commitment to the adult student. For example, to what office or division of the institution is the program directly responsible? How extensively do regular faculty committees participate in decisions regarding engineering continuing education? Is the program part of a cooperative inter-institutional operation? What are the restrictions on admission?

The practices of an institution in offering options to the learner are significant in reflecting how much flexibility exists and how much concern for the individual. In the area of curriculum requirements, for example, may a student begin a program at any time as opposed to only the start of the term? Can the student help design his own program or are most or all of the programs structured and prescribed? Are there individual learning contracts? Is a major required? Is the pace of learning determined by students individually? Is course work possible at several different campuses or other locations? Can the student earn a degree or complete the program entirely on a part-time basis? What other locations besides the campus itself are available to the student for learning activities?

Still on the subject of student options, it is important to know what learning situations are provided to choose from, either separate or in varying combinations. The most common among these are traditional classroom lectures, tutorials, programmed and computer-assisted instruction, tape cassettes, talk-back telephone instruction, closed circuit live talk-back television, closed circuit TV or video tapes with no immediate feedback, broadcast radio or television, field work or cooperative work study, correspondence courses, and occasional short-term campus residency. It is equally important to know which of the options listed above are the major means of learning. Incidentally, this portion of the survey can sometimes reveal favorable institutional intentions but little practical effort to back these with the equipment and materials necessary to carry on such programs.

There are other elements in the area of institutional practice about which information is essential, all contributing to a recognition of the extent of commitment. The times when instruction is scheduled, the proportion of student attrition, the types of recognition of achievement awarded, the nature of the faculty carrying on the program (regular, separate, or special from the community, professions, business or industry), the primary source of funding, the operating costs, and, most vital of all, the amount and types of academic counseling provided -- these are matters offering clues to how seriously the institution views its responsibilities in continuing education.

III.

I have gone into some details in outlining the sort of needs analysis necessary to intelligent and effective planning to show that activity in the adult and continuing education area is not to be undertaken without full realization of the many factors involved or without very specific knowledge about all of them. In concluding, let me now speak more generally about continuing education as we look ahead, whether in engineering or any other discipline. I do so only because I am the final participant in work sessions of this conference and, after more than thirty years of close association with adult learning, cannot resist the temptation to look at it in its broadest aspects.

As presently constituted (and please remember that I am speaking generally), continuing education is an obvious resource. But it has all too often been hampered by rigid definitions of purpose, conventional structures, peripheral and half-hearted acceptance, unnatural budgetary problems, and too much separation from the basic academic program. Some of its earliest characteristics still linger to sap its vitality and complicate its existence.

For example, the fact that continuing education is associated in the minds of many people with purely basic kinds of training has slowed down its progress toward offering the broadest types of service to meet the needs of all ages, levels, and kinds of learning. In spite of unusual opportunities for innovative methods because of the nature of its clientele, it has too often been a pale and emasculated replica of the formal program offered to fulltime students. In contrast to the rest of education it was (and still is, in some places) expected to pay its own way and perhaps a bit more. In the past, some institutions in the United States actually used their continuing education divisions as a major source of income, and instruction in any particular course of study was paid for in accordance with the number of students it attracted. Whether this situation pertains today, I do not know. I certainly hope not. And possibly, because continuing education has been so carefully set apart it has rarely, if ever, been able to gain for itself the recognition and acceptance of the fact that it constitutes a truly important segment of the total educational process of most universities.

A different set of attitudes brings about a different set of results. One of the first continuing education programs, historically and on a national scale in the United States, has been that of agricultural extension. And why has it been so successful? Because it has avoided the characteristics I have just mentioned. It goes out among the people, it usually has a staff of first-rate specialists committed to and concentrating upon their task, it has disregarded and by-passed the conventional structure of the University, and it has been appropriately, even generously, financed. Furthermore, it suffers from no inferiority complexes, nor does it consider itself peripheral to the purposes of the institution with which it is associated. Even when we grant that there are unusual circumstances to explain a good part of this, perhaps there are lessons for continuing education proponents to learn from such a program.

This is a time of new, exciting, difficult educational demands. The appeals of millions of people at all ages to be given speedily what they require for lives of dignity and productivity, the inevitable inadequacies of funds and instructional facilities in many instances, the swift obsolescence of knowledge in specialized fields, the increase of leisure time, the vital necessity for a citizenry that can understand its social and political problems and act upon that understanding -- all these developments and more point clearly to continuing education's growing opportunities. These encompass some of the major directions for education now and in the future.

Given such circumstances, it seems to me unthinkable that continuing education, which is the logical response to these demands and necessities, should still be a thing apart, a retarded stepchild, with no clear and ringing mission and often with puny support. This is why I have said often in the past that the success of continuing education will be in direct proportion to the speed with which it disappears as a separate entity and is considered part of the main mission of a university. It cannot co-exist in a second-class status when it has first-class responsibilities to fulfill.

Interestingly enough, the problems of continuing education could now be solved more easily than ever before if there existed on university campuses a strongly coordinated willingness and desire to meet today's educational issues. New tools, new arrangements, new structures -- already tested in individual instances and found not only promising but successful -- are in the wings, waiting to be called upon and used more widely. They are valid for all education, not continuing education alone. And they will ultimately be used on a large scale. This I would freely predict. But it is also quite possible that we shall move toward these new approaches at a glacier-like pace, hesitantly, reluctantly, ponderously, sometimes even fearfully.

While I have pointed candidly at some of continuing education's failings, let me hasten to say that I am optimistic about what the future may bring. And a good deal of my optimism springs from what I have observed being accomplished in the engineering field. You are truly leaders in continuing education, and your achievements hold out great hope for progress in other fields as well. There are still new heights to scale, but I have confidence that with you in the van of the climbers, the goals will be reached.

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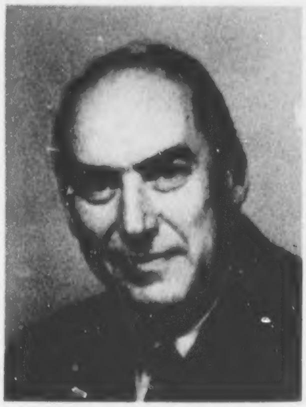

SAMUEL B. GOULD

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WORKSHOP I
MEDIA-BASED CONTINUING EDUCATION FOR ENGINEERS

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This workshop makes available, probably for the first time, a comprehensive and authoratative exposure to media-based continuing education; the history, the development, the successes, the failures, the nuts-and-bolts of how, the fundamentals of why, the state-of-the-art, and the promise of the future.

The workshop features the collective experience of AMCEE (Association for Media-based Continuing Education for Engineers), a consortium of nineteen U.S. engineering colleges. Members are:

- Auburn University
- Case Western Reserve University
- Colorado State University
- Georgia Institute of Technology
- Illinois Institute of Technology
- Massachusetts Institute of Technology
- Purdue University
- Southern Methodist University
- Stanford University
- Polytechnic Institute of New York
- University of California, Davis
- University of Illinois
- University of Kentucky
- University of Maryland
- University of Massachusetts
- University of Michigan
- University of Minnesota
- University of South Carolina
- University of Southern California

Representatives of nine of these members are included in the focused presentations and others of the nineteen will be present to share insights, perceptions, and experiences. Collectively, these members offer over 80% of the media-based engineering outreach programs in U.S. universities. The consortium is supported by funds from the Alfred P. Sloan Foundation, the National Science Foundation, and the member institutions.

The full spectrum of media-based activities will be covered; credit courses, audit courses, studio productions, candid classrooms, short courses, ITV systems, video tapes, facilities, production methods, distribution systems, costs, user profiles and performances, philosophy, pedagogy, trends, and possibilities.

Can those of us responsible for education in technology consider the use of technology to be a threat to education? We think not.

Does changing technology guarantee the obsolescence of the engineering graduate or does changing technology offer the means for continuing professional development? Are the continuous, but changing, needs of engineering graduates a measure of obsolescence--or of growth? Is a failure to recognize and serve these needs not a measure of our own obsolescence?

Participants have an unusual opportunity to probe, to learn, to challenge, to influence both the state-of-the-art and the future of media-based engineering education.

It has been said that if your only tool is a hammer, all problems will appear to be nails. We will explore how to add the media-based tools to your collection and how some of the old and some of the new problems may respond to these tools. Some may prefer to hammer away and curse the resistance of the nails; others may find the nuts-and-bolts of this workshop another way to assemble part of the educational process.

These schools, having learned to interact and share with each other, now offer to interact and share with the world community of engineering education.

John David Waugh is Professor and Dean of Engineering at the University of South Carolina. Dave has been on the College of Engineering staff since 1958 and has worked for Bendix Aviation Corporation as well as having been a private consultant in structural engineering. He has published extensively in the field of structural analysis. He is a registered Professional Engineer in South Carolina and active in the ASEE, ASCE, AAUP, and South Carolina Academy of Sciences. One of the founders of AMCEE, he is an active advocate of instruction using video tape and was responsible for the successful APOGEE program at the University of South Carolina.

LIONEL V. BALDWIN

Lionel received his academic degrees in chemical engineering from the University of Notre Dame (BS, 1954, M.I.T. (SM, 1955) and Case Institute of Technology (Ph.D., 1959). From 1955 to 1961, he performed research at the NACA/NASA Laboratory in Cleveland, Ohio. He moved to Colorado State University in 1961 as an associate professor to teach and continue his research in turbulent fluid flows. Since 1964, he has served as professor and dean of the College of Engineering. He has served as Chairman of the Board of Directors of AMCEE since 1976 to date.

A DECADE OF U.S. ENGINEERING EDUCATION OUTREACH BY VIDEO

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Summary

How television is used by a growing number of major engineering schools in the United States to extend their graduate level and non-credit continuing education courses to practicing engineers off-campus is described. Course delivery methods, the characteristics of the engineer in industry, his course interests, and the university response to those interests are discussed. For those not familiar with them, the important features common to most current instructional television systems are also described.

Introduction

It has been estimated [1,2] that the engineering workforce in the United States numbers over one million people, nearly all men and many without college educations in engineering. Change and diversity in engineering is a way of life. Change occurs not just because of the emergence of new technologies but also because of the shifting of societal attitudes toward technology. Coping with change is hindered by the relatively slow growth of the profession. The median age is 43, and the entry rate of new graduates into engineering today barely exceeds the rate of departure through change of occupation, retirement or death. Further complicating the picture are the variations in demand for engineers both by disipline and on a geographical basis. The skills-mix often does not fit the needs. Some regions in the United States have had significant numbers of unemployed engineers while elsewhere in the country, engineering jobs went unfilled. Continuing education is one technique which can assist engineers to change their fields of expertise as the employment demands shift.

Although there were several initial ventures using the medium of television to extend graduate-level continuing education for engineers beyond campus classroom boundaries, the major thrust of this activity began slightly more than ten years ago and it is this era that will be described here.

The phrase "Outreach by Video" is used to emphasize the distinction between traditional "Educational Television" and Instructional Television (ITV). The former consists of a highly polished, scripted, rehearsed, acted, and edited presentation which is typically used by an on-site local teacher as a supplement or adjunct to the learning process. By contrast, ITV utilizes the video medium as the primary means by which the course instructional content is transmitted live, or via videotape recordings, to persons at one or more distant sites. These remote classroom sites are usually located on the premises of the sponsoring industrial or governmental organizations. The traditional "classroom teacher" is not present.

ITV Delivery Methods

In almost all cases, regular graduate level engineering courses are televised in specially equipped on-campus classrooms with on-campus students in attendance. The class proceedings are not scripted, rehearsed or edited and when televised live, provisions are usually made to include audio communications circuits so that all remote students can interact by voice with the originating classroom as each session proceeds. These "talkback" systems were initially felt to be an essential feature of live ITV courses, particularly for remotely located degree-seeking graduate engineering students. They certainly contributed to faculty acceptance during the early years of live academic video outreach programs. Most live television systems have maintained their talkback systems whenever the cost of the talkback circuits have not become prohibitive.

When surface transported videotape is used as the transmission medium to reach students, student interaction with the course instructor is handled by scheduling consultation hours, during which, remote students can talk to faculty members via telephone. This sometimes leads to timing problems, particularly if the videotape delivery time is long, but experience has shown that it is feasible, particularly if there is no other viable alternative. In cases where telephone consultation is not feasible with videotaped instruction, Gibbons et al [3] report good results using local tutors drawn from the engineering staff at the remote industrial site.

The choice of whether to develop a live or videotape delivery system is determined primarily by economic considerations, with technical and geographical factors sometimes also involved. Generally, in order to satisfy the diverse course content needs of practicing engineers in industry, most universities operate multichannel systems. Typically, each channel can handle 10 to 15 courses per semester, depending on the length of the regular teaching day. For each channel, a separate classroom must be equipped with television origination equipment, and if the class is to be transmitted live, a television channel allocation must be obtained from the appropriate governmental agency for each channel needed.

In the United States, each major population center has one or more television channels set aside for "educational" use but the large number of hours per day necessary to televise just graduate engineering courses precludes the use of these channels. Fortunately, the U.S. Federal Communications Commission anticipated this problem and established 31 channels in the 2500 to 2690 megahertz frequency range for use by educational institutions and organizations in July, 1963. The channels in this microwave frequency range bear the designation of "Instructional Television Fixed Service" (ITFS). The line-of-sight radio wave propagation characteristics of these channels and the low transmitter power allocations allowed, limit the transmission range to about 35 miles from the transmitting antenna location. Thus, a university must be very close to the industrial area it wishes to serve or have an economical means to relay its multichannel television signals to ITFS transmitters located centrally in the industrial area.

In some locations such as mountanious regions, industry is so widely dispersed that even point-to-point microwave relaying and ITFS local area coverage is simply too costly for industrial participants to support the system acquisition and operating costs. In these situations videotape delivery is used exclusively. And finally, some engineering colleges with live delivery systems also use videotape to reach beyond their microwave transmission range. The essential point to note is that although there are many common features of these video delivery systems, each institution that is operating a successful system has tailored it to meet the special needs of the areas and the industries it serves.

Industry Engineer Ages and Interests

In all of the above cases, offering graduate level engineering courses for credit for an advanced degree was the initial objective. However, it has been observed by almost all ITV systems that many engineers in industry do not wish to pursue a degree program and in fact are not interested in taking courses for credit. Viewed as a composite group, the age of attendees ranges from the early twenties to the early sixties. It is primarily those below 30 years of age who wish to pursue an advanced degree, while those above 30 attend to update, upgrade and broaden their technical skills and expertise. Down[4] reports that in the Stanford system, the average age of credit students was 27.9 compared with an average age of 38.1 for audit students. A recent survey of University of Michigan ITV remote students resulted in the age profile shown in Figure 1. Again in this case, all degree seeking students were below the age of 30.

As a consequence of the age distribution and non-credit course preference of many engineers in industry, a growing demand has become apparent for short courses for which academic credit is a secondary consideration. For example, mid-career engineers often have moved into subject areas not covered in their undergraduate programs and thus feel the need to improve their technical or managerial capabilities. Also popular are short courses in currently new technologies or fields such as microprocessors, lasers, fiber optics, finite element analysis, data base management systems, etc.

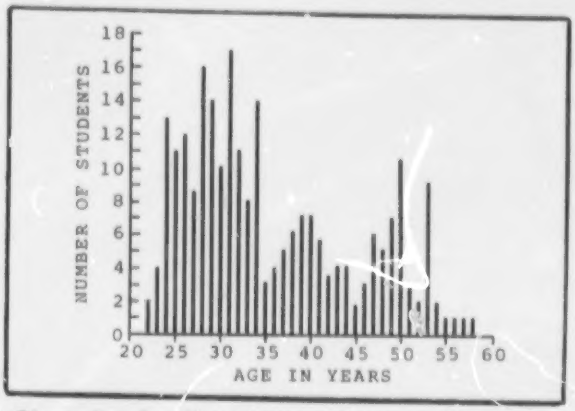

Figure 1. Age Distribution of University of Michigan ITV Students at Industrial Sites During 1974-75.

Video Publishing

The response of at least some engineering schools to this short course interest, has been to encourage interested faculty members to prepare such courses in the requested subject areas. Often, the tutorial approach is modified to introduce a substantial self-study component into the course design. Typically a series of video tapes are prepared by one or more faculty members along with a coordinated study guide, a textbook and other reference materials. In the case of microprocessor courses for example, arrangements are also made for each student to use a microprocessor trainer so that hands-on experience can be acquired with a functional microprocessor during the period of the course.

In contrast to the regular academic courses that are televised live with on-campus students in attendance, special attention is given to the production of video tapes used in the short courses. The tapes are recorded in a standard production studio with no students present. The presentations are carefully organized and paced, professionally produced graphics, visual materials

TABLE 1

ACADEMIC CREDIT
ENGINEERING GRADUATE PROGRAMS OFFERED OFF-CAMPUS BY TELEVISION
1977-78

Institution (Starting Date)	Delivery Method	Remote Locations	Total Courses	Total Enrolled	Graduate Business Courses
Univ. Rhode Island (1961)	Microwave	1	5	10	No
Southern Methodist Univ.(1967)	Microwave+ITFS	14	40	285	No
Colorado State Univ. (1967)	Videotape	75	98	849	Yes
Univ. of Tennessee (1967)	Videotape	20	39	523	Yes
Univ. of Colorado (1968)	ITFS+Videotape	31	16	252	No
Stanford Univ. (1969)	ITFS+Videotape	40	153	1201	No
Iowa State Univ. (1969)	Videotape	16	44	369	No
Univ. South Carolina (1969)	ETV+Videotape	18	32	600	Yes
Mass. Inst. of Tech. (1969)	Videotape	9	8	143	No
Univ. of Kentucky (1969)	Videotape		Only offered non-credit		
Univ. of Michigan (1970)	Leased Microwave+ITFS	10	43	747	Yes
Univ. of Cal/Davis (1970)	Microwave+Cable TV	10	75	252	Yes
Purdue Univ. (1970)	Microwave+ITFS+Videotape	6	16	358	No
Univ.Cal/Santa Barbara (1971)	Microwave+ITFS+Videotape	2	41	58	No
Univ. Minnesota (1971)	Microwave+ITFS	4	56	304	No
Rochester Inst. Tech. (1971)	Videotape	2	3	100	No
Oklahoma State Sys. (1972)	Microwave+ITFS	NA	NA	NA	Yes
Case Western Reserve (1972)	ITFS+Videotape	31	53	50	Yes
Univ. Southern Cal. (1972)	ITFS	22	79	795	No
Univ. Arizona (1972)	Videotape	10	25	100	Yes
Cornell Univ. (1973)	Videotape	2	12	25	No
Univ. of Wisconsin (1974)	ETV+Videotape	200	230	154	No
Univ. of Idaho (1975)	Videotape	25	19	200	No
Univ. of Mass. (1975)	Videotape	6	14	100	No
Illinois Inst. Tech. (1978)	ITFS	12	68	304	Yes

and special effects are used, and the recordings are usually made in color. Videotaped courses prepared in this manner are shorter in length but much more costly to produce than videotapes of regular academic courses in which no scripting, rehersals or editing to eliminate typical classroom pauses is utilized. Video tapes of regular academic classroom proceedings are often referred to as "candid classroom" courses to distinguish them from the "studio produced" short courses.

The availability of a growing number of studio produced short courses is a relatively recent development and as yet, only a few engineering schools are involved. As mentioned above, production costs are relatively high and generally must be recovered by rental and sales of the video tapes either directly to industry or to other universities for use in their own delivery systems. The financial risks involved have hindered the production of these short courses but those produced have been successful enough to stimulate considerable interest in this area. The production of these video taped short courses has been called "video publishing," and if the present trend continues, it is likely that more engineering schools will initiate such ventures in the near future.

University ITV Systems

Table 1 lists the universities currently operating videobased graduate engineering outreach programs together with the following information: program starting date, delivery method, number of remote locations served, number of engineering courses, total enrollments off-campus (credit and audit), and an indication of those schools which also include graduate level business courses in the delivery system. The list is an adaptation of one originally compiled by Schmalling[5] and recently updated by Baldwin. Not included in the tabulation are: schools with ITV systems previously initiated but not currently operating (4), schools known to be operating, constructing, or planning ITV systems subsequent to 1978 (5), and one school (University of Illinois/Urbana, 1967) using a narrow bandwidth communication system for remote teaching which can be described as "blackboard by wire." The technique involves using a special spatially scanned blackboard plus electronic circuitry which encodes all chalkmarks written or drawn on the board, along with the instructor's voice. The encoded signal is transmitted via a voice-grade telephone line to a remote site equipped with a compatible decoder connected to a standard video monitor. The monitor displays a video image which faithfully reproduces all of the originating blackboard markings.

In all of the ITV systems listed in Table 1, federal funds were not a significant factor in their development. Private foundation donations, user subscriptions to a capital fund, and state and university funds built the facilities. It has been estimated that the aggregate capital investment of the ITV systems is in excess of $20 million dollars. Operating funds are derived primarily from tuition fees, from enrollees, and industry membership fees. Since most firms have tuition reimbursement programs for their employees, participating companies and governmental agencies provide the major bulk of the operating funds. Studies at several ITV operations have shown that the major operating cost is administrative program management and technical manpower to run the video systems.[6] No provision is made to pay the instructor an incremental amount for teaching on television in most systems. The rationale is that the teacher is simply adding off-campus students to a regularly scheduled class. This position is sometimes modified when significant time delay is necessary because of videotape shipment but that is usually the only exception. Every effort is made to keep the overall operating cost as low as possible so that industry support is not limited to only a few of the largest firms within a university video outreach area. Developing a large and diverse industrial and governmental agency participant group will increase operating revenue without substantially increasing costs. This will enable a system to offer a broader spectrum of courses and arrange for orderly growth which is essential if more engineers are to be reached.

Figure 2 shows the steady growth of these off-campus graduate programs nationally. The enrollment data includes non-credit course attendance discussed above. The growth illustrated is evidence that both costs and results are acceptable to the industries and government agencies that support these programs. All indications are that the number of ITV systems will continue to increase but perhaps at a somewhat reduced rate because most of the largest industrial concentration areas are now within the delivery area of an operating system. Expansion to 3 or 4 channels is also feasible for most systems and it is in this way that further growth is likely.

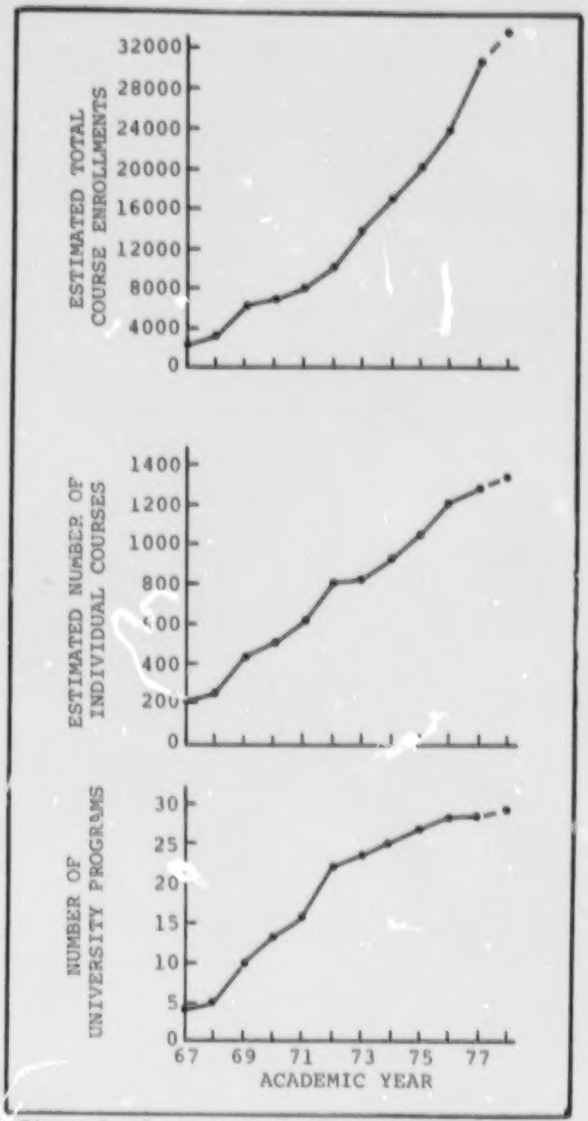

Figure 2. Engineering Graduate Programs Offered Off-Campus by Television

National Collaboration

More than five years ago, it was recognized that engineering schools operating ITV systems whether live or via video tape, might benefit from some form of mutual information and possibly even course exchange. This in turn would enable them all to more adequately meet the continuing educational needs of practicing engineers in industry and government. With the aid of a small National Science Foundation grant, Dr. Lionel V. Baldwin, Dean of Engineering at Colorado State University successfully initiated such collaboration beginning in 1974. The resulting organization, the Association for Media-Based Continuing Education for Engineers (AMCEE) is now a nineteen university consortium formed in 1976 to increase the national effectiveness of continuing education for engineers. AMCEE and its activities are described in companion papers.[7,8]

ITV System and Classroom Features

It was mentioned earlier in this discussion that the "candid classroom" televised course consisted of the televised proceedings of a typical graduate level engineering course, devoid of all of the time and manpower consuming features of educational television such as scripting, rehearsing, editing and complicated graphics. In spite of the removal of those constraints, however, there are several features which must be included in the design of a successful ITV system. They can be listed as follows:

1. It is desirable to retain the traditional classroom environment as far as possible to maximize faculty and student acceptance.
2. It should be possible to televise all typical classroom activities such as lectures, demonstrations, student presentations, seminars, and the use of slides, transparencies and motion picture films.
3. The classroom and its equipment should be designed to provide and enhance teaching flexibility and to minimize the teaching constraints introduced by television.
4. There should be no hot lights or television personnel in attendance to inhibit the actions of the teacher or students.
5. Provisions should be made to adequately pickup both the instructor and student voices throughout the classroom.
6. All equipment should be capable of producing good quality video and audio output.
7. The system should be designed to minimize the number of operating personnel required.
8. Particular attention must be given to ease of maintenance and system reliability.
9. Although color television is not mandatory, system design should contemplate the future conversion to color with a minimum of re-equipping. Several ITV systems in the U.S. either have or are in the process of converting to color operation.

A typical ITV classroom will have most or all of the following features:

1. The student seating area is furnished with strip-tables with 6 to 8 seats across and 4 or more rows deep.
2. The front of the classroom often has a reaised platform with at least three quarters of the front wall width covered by a blackboard. The front wall is usually equipped with pull drapes to cover the board when desired.
3. An instructor's desk is located facing the students at the platform front and center.
4. Three television cameras, each mounted on a remotely controllable pan and tilt unit are used in the classroom. Each camera is equipped with a lense with remotely operated zoom, focus and iris controls. The zoom ratio is typically 10 to 1. One camera is mounted at the rear of the room and provides a view of the instructor at the desk, or alternately, at the blackboard. The second camera is located in the front of the room and is mounted directly above the instructor's desk and pointed vertically down upon it. This permits the instructor to use a note pad for the presentation of written notes or any other kind of visual materials, such as close-ups of textbook pages, photographs, drawings, models, etc. Some instructors use the desk pad and a fine-tipped felt pen to present their complete classroom lecture without any recourse to the blackboard. The third camera is usually mounted in the front of the classroom on a side wall and positioned so that it can either provide a side view of the front desk area or view the student seating area.
5. Video monitors for the local students are also required because when the instructor is using the front overhead camera, that image must be viewed by all students. In some classroom designs, this is accomplished by having a large video monitor on each side of the front of the room and positioned for class viewing. An alternate design has small video monitors partially recessed in the strip tables and positioned so that each adjacent pair of students can share a monitor. An eight seat strip-table therefore, would contain 4 video monitors. In either design the front desk also is equipped with a small recessed video monitor so that the instructor can view the outgoing video image. This is particularly important when the front overhead camera is in use.
6. Microphones are also required in the television classroom, both for the instructor and students. Sound pickup and room acoustics often are given inadequate attention and are beyond the scope of this discussion because individual room characteristics and microphone placement can strongly affect the resultant audio quality.
7. A final feature of most ITV classrooms is a viewing window at the rear of the classroom. This window

separates the classroom from its adjacent but acoustically isolated control room.

8. The classroom control room typically contains an equipment control console in which is mounted all of the television camera and lense controls, the pan and tilt controls, the video special effects and switching system, the audio level controls and all monitoring and other auxiliary systems required to provide full video and audio coverage of the classroom activities. The system is designed so that one person can monitor and control all of the classroom video and audio equipment. In effect, the control console operator performs all of the functions of the camera operator, the sound operator, the technical director and the director-producer. For those accustomed to traditional television procedures, this ubiquity might be difficult to imagine, but it is accomplished regularly with one person at most ITV locations. Usually, local students are trained and employed on a part-time basis as control console operators.

The remainder of an ITV system consists of a master control and maintenance area containing equipment common to typical television operations. Videotape recorders, a film chain, ITFS transmitters (if used), switching, monitoring, control, and test equipment are the major items required. Generally, the equipment types are a mixture of "broadcast" and "closed-circuit" television quality so that system costs do not become excessive. Typically a two-channel ITFS system with non-broadcast quality videotape recorders currently costs $350-$400 thousand dollars exclusive of major building modifications. Further typical system details are described by Pettit and Grace,[9] Martin-Vegue et al,[10] and Vail and Bush.[11]

ITV systems in the U.S. have demonstrated by their growth that they are meeting at least one important component of need for continuing education by engineers, scientists and technical managers. Anyone considering the establishment of a similar system can help assure its success by taking the following steps:

1. Conduct a realistic survey of the industries to be served to verify that a sufficient number of engineers will participate and that their employers will provide the necessary economic support.
2. Solicit and obtain the sincere support of both the faculty and top administrators.
3. Tailor the ITV system operational and delivery characteristics to meet the user needs.
4. Visit or seek advice from one or more experienced ITV system operators. It is likely that they have done the same!

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Prior experience includes both research and teaching at Michigan since graduation. He has been a consultant to industrial firms and to other universities planning Instructional Television Systems. His professional affiliations include ASEE, IEEE, SMPTE, AAAS, Eta Kappa Nu and Sigma Xi.

He is a member of the Board of Directors and Treasurer of AMCEE, the Association for Media-Based Continuing Education for Engineers, Inc., a consortium of nineteen universities formed to improve the national effectiveness of continuing education for engineers.

MARKETING CONTINUING EDUCATION MATERIALS WORLD-WIDE

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Summary

Only one AMCEE member, namely MIT, has made a systematic effort to market its videotape course materials outside the United States. It has been found that (1) foreign clients tend to purchase rather than rent the courses with a consequent larger value to each such transaction, and (2) foreign universities are among the client population in much larger proportion than is tue domestically. Contact with prospective clients can be made both through foreign representatives as well as by direct mail solicitation. Various governmental agencies and private organizations appear interested in fostering this exchange. It is not, however, without its problems, notably in video format incompatibility and in the language barrier. Nevertheless, the program is counted a success and the effort is being continued.

The "Candid Classroom"

AMCEE has not, as an association, tried to distribute its media-based continuing education programs outside the United States. One obstacle has been the philosophy - inherent in most of the member programs - of retrieving videotapes and erasing them after a single useage. There have been two principle reasons for this policy: (1) the "candid classroom" videotapes were never meant to be recorded "for posterity," and many faculty insist that they be erased, and (2) because the university member record so many courses, they would face very large and expensive inventories of videotapes if they were to keep copies of all of them.

This policy has already been modified in several individual cases where it was inconvenient or impossible for a client to take a course at the time or on the schedule dictated by the university. Fees have been worked out, on an ad hoc basis, to permit extended rentals, long-term leases, or even outright purchases of some of these "candid classroom" courses.

Videotape Short Courses

On the other hand, there has been no such inhibitory factor militating against the use of videotape short courses abroad. The reason is simply that these short courses are usually recorded specifically for the continuing education market, even though that was initially seen as a domestic market. As a result, these short courses are usually recorded in a studio rather than a classroom with the intent that they be preserved and used over a period of years.

The self-study program at the Massachusetts Institute of Technology's Center for Advanced Engineering Study was built up entirely around this concept of producing and distributing high-quality videotape short courses, designed to last indefinitely. (Many, in fact, are basic subjects the content of which changes only very slowly; at least initially, MIT stayed away from "state-of-the-art" courses which, it was thought, wouldn't last long enough for the institute to recoup its investment.) Since that program started in 1968, other members of AMCEE notably Colorado State University - have recorded similar short courses, and now AMCEE itself is recording such courses on behalf of the association.

The International Market

As I have said, the initial market for these videotape short courses was seen to be a domestic one, and MIT made no effort to explore an international market until 1976. The program had gotten off to a slow start in the United States, and I doubt anyone really gave much thought to trying to go outside the country for additional distribution. But, in 1976, a couple of orders arrived "over the transom" (as home offices are wont to describe such unsolicited orders) that caused us to re-assess our position vis-a-vis the foreign market. The first order was from a large industrial firm in

Europe for the rental of a short course. The firm was a member of MIT's Industrial Liaison Program and had heard about the videotape courses through their MIT contact. I must say that the firm showed incredible patience with our shortcomings and tenacity to the concept of media-based continuing education, for Murphy's Law certainly has no local boundaries. Everything, semingly, that could go wrong or make it difficult to implement the program, did. We knew nothing about customs formalities or proforma invoices, and they had to learn about format incompatibilities and taking courses in a foreign language. But we learned, and they learned, and the experiment grew to be a significant success for both parties. Their initial rental turned into an outright purchase - not only of that course, but several others.

Two Lessons Learned

And at this point, we learned our first significant lesson: foreign clients were more likely to purchase a course outright than to rent it, rentals being the principal mode in the U.S. And, since the purchase price of a course is five or six times the rental fee, it follows that a foreign order is likely to be worth five or six times as much as a domestic order. Hence, it appeared to be worth developing the skills necessary to deal with those customs formalities and proforma invoices.

The other order we received at about that time came from a European university. We suspect it resulted from a visit by the professor who had developed the courses to a colleague at that university, during which he may causally have mentioned the existence of these materials. At any rate, an inquiry arrived, followed by an order for one of the short courses.

And now we learned our second lesson: whereas domestic rentals and sales of videotape courses are almost entirely to industry and government and almost never to other universities, (because "not invented here") the foreign market includes many schools which have no such inhibition against importing courses (or, at least, are able to overcome the opposition).

As a result, then, of these early and largely serendipitous orders, we began a deliberate campaign to obtain such orders. And, although the results - even after more than two years - are still widely scattered, they have more than justified the marketing and sales promotion expense invested and have confirmed our suspicion that there is a genuine and accessible market for videotape courses - despite the barriers of format and language.

Representatives and Distributors

In order to develop the foreign market, we explored the two traditional avenues of representative and direct mail sales. Domestically, we had a few representative agreements but had achieved our best results through our own direct mail efforts. We had evolved a sales representative/distributor contract which we could use as a model for working with similar companies in the foreign market. It called for paying a commission on rental orders forwarded to us and for allowing a larger discount on outright purchases, where we had a larger margin to work with.

Initially, we tried two types of representation: (1) domestic firms specializing in import and export in the education market and (2) foreign firms engaged in similar activities. Through our marketing consultant, we obtained names of a handful of domestic firms and several lists of foreign firms. The latter were, for the most part, audio-visual dealers representing U.S. manufacturers of projectors and films and Japanese manufacturers of video equipment. Altogether, we solicited inquiries from 775 firms.

The solicitation comprised three steps. All 775 were sent an initial letter announcing our interest in working with representatives and distributors and inviting an indication of reciprocal interest. Those that responded (about 50) were sent, by air, a complete catalog of courses and a set of terms. And, finally, those that accepted the terms were sent a letter of appointment for a trial period together with 50 catalogs (they could, of course, order more) and whatever sales promotion information we considered helpful.

By the end of the year, we had taken on about four domestic firms specializing in foreign distribution and about 20 foreign firms. It is significant that the domestic firms never obtained a single foreign order and were eventually dropped and that what success we had was entirely due to the foreign firms. Presumably they were on the scene, knew their clients, and could help answer the myriad questions and solve the seemingly interminable problems that arose. (As you might suspect, the time scale for obtaining and delivering an international order was an order of magnitude greater than for a typical domestic order; we soon ceased to be surprised to receive an order more than a year after an initial inquiry.)

In 1977, the total number of foreign representatives and distributors rose to about 35 and we began to receive some significant orders. In some cases, the representative screened us from contact with the actual user and we never learned the ultimate destination of the materials; in other cases, we corresponded with the client while, at the same time, we protected the interests of our representative. It does appear, however, that the majority of these courses were destined for foreign universities.

Direct Mail

Because our domestic success had resulted largely from our direct mail efforts, we added direct mail solicitation to our search for foreign representation. And, although we would have normally weighted our mailing lists heavily toward industry, our second lesson, described earlier, had suggested we go just as heavily for the university market. We mailed to a list of foreign "Fortune 500" companies, which were located largely, of course, in Germany, Japan, and other highly industrialized countries. And we systematically mailed to Deans of Engineering and others at universities throughout the world. The time scale for responses, inquiries, and orders is so long that it's difficult to assess the success of this campaign. But, I can say that orders from a single university in the Far East paid for the mailing costs many times over.

Other Activities

In addition to the acquisition of a dealer network and our own direct mail efforts, we also sought assistance from various government and private agencies. These included the International Chambers of Commerce, the Agency for International Development, the Organization of American States, the U.S. Information Agency, UNESCO, the United Nations Development program, ALESCO, ARAMCO, etc. etc. These contacts were by letter, telephone, and personal contact. Although it would be difficult to attribute specific results to these contacts, it seems safe to say that they helped us a great deal - not just in providing leads - but in understanding the international market a little better. And, in that sense, the effort was well worth the investment.

Problems and Solutions

It would be unfair not to mention, in passing, some of the problems one is bound to encounter in marketing videotape continuing education materials in the international market. One important obstacle is the compatibility problem. As you probably know, there are three incompatible video format standards in the world: NTSC, PAL, and SECAM; and, as I understand it, there are even variations of those standards. Although it is routine for the major television producers to convert from one standard to another (how else would Americans ever get to watch "Upstairs, Downstairs"?) the cost is prohibitive for our purposes - on the order of US $1,000 per hour. As a result, we have had to insist that clients in non-NTSC countries obtain NTSC-compatible equipment for showing the tapes. This, of course, is not an inconsequential expense. Furthermore, we received little cooperation from the one manufacturer, of whom we are aware, who manufactures multiple-standard equipment, in obtaining model numbers and distributor names for the benefit of prospective clients. On the other hand, the equipment is available and the highly motivated and persistent client can find it.

Another problem is, obviously, the language barrier. Again, although it is routine to "dub" different language soundtracks for mass audience film and television programs, it it out of the question in the limited market we reach. One of our clients, in fact, tried to transcribe, translate, and record an Italian soundtrack for a series on Nonlinear Vibrations. He quickly found it was simpler to insist that the students acquire enough English to take this graduate-level course in English. Just in passing, I want to note that it has been interesting and puzzling to us that almost all our orders have come from non-English speaking countries.

And there has been a myriad of other, smaller obstacles to overcome, many of which, perhaps, we might have avoided if we had chosen to work through export companies, customs brokers, etc. rather than in the typically arrogant academic way of assuming we could fathom for ourselves any regulation, procedure, or system - no matter how obscure or complex. Just one example: Canada. Did you know, for instance, that there is no air parcel post service to Canada? - an anomaly unique to that country, as far as I know. Or that if you send more than $200 worth of materials to Canada, you must obtain and send a special Canadian customs form - in quintuplicate - to your client so he can receive what you've sent him? Or that, unless you file for a special tax exemption under Chapter X of some code, your Canadian client is obligated to withhold ten percent of your fee for Canadian income tax? And these are the peculiarities of dealing with just one country! And, hopefully, a friendly neighbor at that!

These minor hurdles and obstacles can, however, all be overcome with experience and patience, and one can also learn about letters of credit, international bank transfers and other ways of getting paid for services rendered.

Conclusion

In conclusion, let me say that, despite the frustrations, delays and other problems, the effort to share our continuing education activities with those outside our own countery has been well worthwhile. And although I am forced to use the language of commerce in talking about proforma invoices and bills of lading and letters of credit, I don't think any of us ever loses sight of the real reason for our effort. Just like teachers everywhere, we are compelled from within to spread the gospel, to teach those that want to learn. And media-based materials just make it possible not only to reach those outside our university - but now, to reach those who want to learn - anywhere in the world.

Note: The author wishes gratefully to acknowledge the assistance of Mr. Richard Noyes not only in the design of the international marketing program at MIT but also in the preparation of this report.

JOHN T. FITCH

John T. Fitch is Director, Technology-Based Educational Development and Marketing at the Center for Advanced Engineering Study, Massachusetts Institute of Technology. At the present time, however, he is on a one year leave of absence from MIT to serve as Executive Director of AMCEE, the Association for Media-based Continuing Education for Engineers, Inc., based at the Georgia Institute of Technology.

For the past ten years, Mr. Fitch has headed a program in the development of high-quality self-study subjects for engineers. These courses comprise color videotapes, study guides, and textbooks, and are now being distributed throughout the world. Prior to joining the staff of MIT, Mr. Fitch, who is himself an electrical engineering graduate of the Institute, worked in commercial broadcasting, as a technical writer/editor, and as a producer of educational films in the physical sciences.

THE AMCEE BACKGROUND AND STATUS OF OVERALL ACTIVITY

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Summary

A number of universities in the United States has for some years been using television to make their engineering courses more readily available to working engineers at off-campus locations. Recently, those universities most actively involved in these efforts organized as a consortium in an effort to use their collective resources and industry relationships to increase national effectiveness in the continuing education of engineers. This consortium is known as the Association for Media-Based Continuing Education for Engineers (AMCEE). The background of the organizational effort and some of AMCEE's current and planned activities are discussed.

Background

As discussed in another talk in this session, over the past decade in the United States, a growing number of schools of engineering have been using television to carry their educational resources directly to industry for both degree-oriented and continuing education purposes. This is being accomplished both by broadcasting courses "live" to industry or, on a delayed basis, by videorecording courses and delivering the tapes to companies for later replay. This use of technology to so alter the traditional patterns of university attendance is making it easier for part-time students in industry to pursue graduate degrees in engineering without undue disruption of work schedules. But, these efforts are also having a major impact on continuing education as well. These broadcast and tape systems, by providing easily accessible university courses within the work environment, are enlisting greater participation in continuing education by employed engineers than would otherwise be the case.

There are in the country today about 20 universities that broadcast courses to industry using ITFS systems, microwave links, ETV or leased lines. Another 15 or so are serving industry needs by phsyically delivering videotaped courses. Some schools use both approaches -- broadcasting to companies in their immediate vicinity and mailing videotapes to distant locations. In many of these systems, courses in disciplines other than engineering, both for credit and noncredit, are also offered.

All these schools are providing industry with educational services beyond the normal university functions. In doing so, each school has developed special relationships with a number of client companies -- highly regional relationships in the broadcast systems and sometimes more extended in the tape delivery systems. Each system is, in fact, a university-industry educational delivery network and today, after more than a decade of development, there are many such networks around the country involving dozens of universities and hundreds of companies and government organizations.

In the continuing evolution of such educational networks, it would seem natural that the next step might be establishment of some agency to promote cooperation among these many independent systems to make most effective use of their collective resources. The situation, at least with respect to the regional broadcast systems, is analogous to public and commercial television wherein national networks, providing interconnections between many local networks, have been highly effective in promoting the exchange and broad distribution of programs throughout the country.

Even without such a coordinating agency in the educational sphere, there have been instances of informal exchanges between the delivery systems of various schools. For example, the University of Southern California, in noncredit offerings over its ITFS system, has for several years been using videotaped courses from the Stanford ITV network from the tape delivery systems of MIT and Colorado State University. Also, courses from Colorado State University have, for some time, been promoted in MIT's nationally distributed catalog of videotaped continuing education courses.

With university broadcast and tape delivery systems proliferating around the country, the much needed coordinating agency finally appeared in 1975 with creation of the Association for Media Based Continuing Education for Engineers (AMCEE). Before explaining in more detail AMCEE's objectives and current activities, some background on how it was created and the broader motivations involved in its formation will first be presented.

Creation of AMCEE

About three years ago, several managers of university instructional television systems, both broadcast and tape delivery, began informally to meet to discuss how their individual media-based approaches to continuing engineering education might be made even more effective when applied collectively. The dominant figure in these early discussions was Lionel Baldwin, Dean of the School of Engineering at Colorado State University. Those involved were guided by the theme: To Increase National Effectiveness in the Continuing Education of Engineers.

The first of these meetings was at the "Workshop on Continuing Education for Engineers at Mid-Career" held in Dallas, August 21-22, 1974. This meeting, sponsored by the National Science Foundation, was attended by representatives from many universities with operating television educational delivery systems and from industrial and government organizations that were actual or potential beneficiaries of their programs.

These early discussions focussed on obstacles to broader participation in continuing education by the nation's engineers and how media-based programs might help to overcome them. Some of the important considerations were identified to be:

(1) Only a small fraction of the working engineering population can muster the time and effort to travel after work to attend specialized classes. Television can make these same courses available inplant.

(2) Engineering populations outside the metropolitan areas are growing. Television can take a course to the remotest locations and economically serve low concentrations of students.

(3) Few schools can afford the manpower and talent to determine continuing education needs, develop courses, find good instructors and advertise courses. Television can make the best courses and instructors available to large numbers of students at any time and at any place.

(4) Much of traditional university instruction is not attuned to the continuing education needs of mature engineers. Television, by encouraging universities to deal more directly with industry clients, can result in courses better tailored for the working engineer.

Other advantages of television were deemed to be:

(1) Possibilities for broad distribution can spread the cost of course development over many students.

(2) Taped courses can be kept in company libraries for repetitive use.

(3) Student evaluation can easily lead to improvement and updating of specific segments of a course.

(4) Videotaped courses provide great time flexibility -- an important factor for the working engineer who must often travel.

(5) Even with taped courses, interaction is possible by telephone office hours or by the tape-tutor mode.

(6) Video instruction at the place of employment is so convenient that the motivation threshold required to participate is lowered, thereby resulting in greater employee participation.

After reaffirming the many advantages instructional television can offer, attention narrowed upon the possible benefits of concerted action by the many schools involved and the planning of a unique and ambitious project capable of a pervasive impact on continuing engineering education nationally.

The co-directors of the Dallas workshop continued to meet to pursue these objectives. In February, 1975, a planning grant was obtained from the Alfred P. Sloan Foundation to provide support for the expenses of several additional planning meetings. In April, 1975, the first organizational meeting was held in Dallas. The co-directors of the planning grant were institutional representatives from Colorado State University, the Association for Continuing Education at Stanford, Southern Methodist University and the Massachusetts Institute of Technology. General goals and plans for development of a more formal organization were formulated.

At the next meeting at Colorado State University in June, 1975, three more institutional representatives joined the group -- from Stanford University, Georgia Tech and the University of South Carolina. Additional planning was done at Stanford in October 1975. At that meeting, it was decided to develop a set of by-laws for formation of a non-profit corporation comprised of universities actively using television in engineering education. A limited number of new organizations was sought to form the charter membership.

At the regular session of the Bicentennial College-Industry-Education Conference of the ASEE in Orlando, Florida in January 1976, the goals of AMCEE were first presented publicly so that all interested parties might be informed and be able to offer suggestions. Preceeding the Orlando meeting, the by-laws were discussed by the charter members at a meeting at the University of South Carolina.

At MIT in March 1976, officers and directors of AMCEE were elected and subsequently AMCEE was incorporated as a non-profit corporation in the state of Georgia. The charter membership consisted of 12 universities. In April 1976, a proposal from Georgia Tech offering to serve as host for the consortium was accepted by the Board of Directors.

The following list of universities are charter members of AMCEE. It is followed by another group that later applied for admission and was accepted in accordance with an agreed upon set of qualification criteria.

Charter Members

Case Western Reserve University
Colorado State University
Georgia Institute of Technology
Illinois Institute of Technology
Massachusetts Institute of Technology
Southern Methodist University
Stanford University
University of Michigan
University of Minnesota
University of South Carolina
University of Southern California
University of California at Davis

Later Members

Auburn University
Polytechnic Institute of New York

Purdue University
University of Kentucky
University of Illinois at Urbana
University of Maryland
University of Massachusetts at Amherst

AMCEE's Goals

As stated in its Articles of Incorporation, AMCEE's specific objectives are:

(1) to establish, on a national level, a network of member institutions that are using media-based educational methods for continuing education;

(2) to provide a forum for discussion on issues of mutual interest;

(3) to enable member institutions producing and broadcasting educational materials to reach a consensus on standards governing production of materials;

(4) to provide a clearinghouse for information about courses available from member institutions; and

(5) to undertake other activities and functions that promote and facilitate the use of media-based instruction by member institutions of the corporation.

In working to achieve its goals, AMCEE is governed by an Executive Director and a board of Directors. They, in turn, receive guidance from an Industrial Advisory Board representing various industries, geographical areas and company functions with a common interest in the continuing education of engineers, industrial scientists and technical managers. Advisory Board members are recommended by the AMCEE member universities.

Operational Aspects

The work of the association is carried out by a number of committees. A Co-Management of Education Committee works with industry representatives to determine the needs of potential clients and communicates these needs to member universities. This feedback is aided by organized needs -- assessment efforts and by sponsorship of joint AMCEE-industry conferences and workshops. A Materials Development and Utilization Committee promotes the sharing of media-based materials among the AMCEE member schools, seeks to stimulate the production of media-based courses and assists in distribution of produced materials. In addition, there is the Instructional Research Committee, a Membership Committee and a Credentialing Committee.

An on-going program of formative evaluation is also underway. This effort evaluates existing materials and projects and the overall approach. It also seeks to insure that research results are tested and disseminated.

AMCEE's long range goal is to be completely self supporting from income generated from entrepreneurial efforts in meeting the continuing engineering needs of the working engineering population, not only domestically, but on an international scale. During its organization and formative stages, however, AMCEE has been partially supported from two grants.

One grant has been provided by the Alfred P. Sloan Foundation as a follow-on of its earlier planning grant. This grant serves as a revolving fund to support the production of courses. AMCEE or any of the individual member schools can propose to borrow against these funds to produce a media-based course and pay back the loan from the income generated from leases or sales.

The National Science Foundation is also supporting AMCEE with a multi-year grant. These funds support the basic operations of the organization during its initial build up period. However, in its desire to become, in time, completely self-supporting, AMCEE is working to establish a broad range of service-oriented enterprises. Independent income is already being generated from several of the projects listed in the next section.

Typical AMCEE Activities Today

To provide some feeling for the directions in which AMCEE is moving today, some representative recent activities are highlighted below:

1. Satellite Network:
AMCEE has conducted a detailed study and developed a proposal to provide for satellite interconnection of its various local subnetworks as well as direct delivery of educational material to industry and government on an international scale. It hopes to implement these plans someday when funds can be made available.

2. Consolidated Catalog of Videotaped Courses from Member Universities:
As described in greater detail in another talk in this session, AMCEE schools have produced a catalog of both classroom "live" and studio-produced courses available for lease to industry and government. This is an interim "United Parcel" version of the satellite system.

3. Consortium-Produced Courses:
Member universities, in an initial experimental effort, have cooperated to produce a videotaped course on Solar Energy with each school involved contributing one or two lectures in an area of its greatest expertise. The course has been distributed by several university networks to their industry clientele. At the University of Southern California, this was done in the broadcast mode.

4. Member-University Produced Courses Using Revolving Fund:
Videotaped courses are also being produced by member schools on a speculative basis by drawing upon the revolving fund. Subjects include "Plant Energy Conversion", "Control Theory Design" and "Welding and Heat Treating".

5. Cooperation with Professional Societies:
AMCEE recently organized a conference to promote closer cooperation with the professional societies in the area of media-based continuing education.

6. Sponsorship of Technical Conferences and Video-publishing of Proceedings:
AMCEE recently sponsored a national conference on "Energy Auditing," drawing experts from around the country, for the express purpose of publishing the proceedings and making them available nationwide.

7. Experimental Projects with Satellites and Cable: AMCEE is cooperating to arrange broadcasts of AMCEE courses on an experimental basis over the Appalachian Educational Satellite system and the American Television and Communications (ATC) cable networks in Orlando, Houston and Seattle.

Outlook

Three years after it was formally established as a non-profit organization, AMCEE is a functioning consortium with a surprisingly high degree of coordination among its 19 member universities. AMCEE can bring to bear upon the national continuing education problem an impressive array of resources -- $8 million in technological delivery systems, several thousand faculty, about a thousand courses being broadcast or videotaped, nearly 20,000 current enrollments in these courses, formal service relationships with hundreds of companies and broad geographical coverage throughout the United States. The organization is on its way towards its goal of becoming a powerful, self-supporting vehicle for the delivery of relevant and timely continuing education to every point of the country, and even the world, in a cost effective manner.

JACK MUNUSHIAN

Jack Munushian received his B.S. in physics from the University of Rochester in 1948 and a Ph.D. in Electrical Engineering from the University of California at Berkeley in 1954. He has been on the staff of the Hughes Aircraft Co. and served as Head of the Solid State Electronics Department at the Aerospace Corporation. In 1968 he joined the faculty of the University of Southern California as Professor of Electrical Engineering. He was responsible for development of USC's Instructional Television Network and serves as its Director. He is also Director of the Graduate Center for Engineering Sciences, responsible for general administration of the School of Engineering.

SOME FUTURE TRENDS IN TECHNOLOGICALLY AIDED ENGINEERING EDUCATION

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Summary

Future application of educational technology may provide both improved cost-effectiveness and better means for serving needs for continuing education for engineers in industry. To illustrate how such use must consider the appropriateness and costs involved, several examples are discussed. Experience at Stanford University with tutored video instruction is described and comments made about future trends. The application of the newly emerging videodisc for engineering education is mentioned. Some comments about use of large and small computers for education are made with some discussion of the Stanford experience, and the possibility for the implementation of remote access to full text of library documents is argued as being feasible.

The Need

The need is two-fold; institutions providing engineering education are faced with rising costs and the pressure for increasing productivity. The engineer no longer in school needs to maintain his skills in a rapidly changing profession to avoid obsolescence. It is natural to turn to the use of educational technology to assist in meeting both of these needs. As has been found many times in the past, however, the availability of educational technogical innovation, whatever its capability, is not enough; consideration must also be given to the educational appropriateness, acceptability to the students and the instructors, ease and costs of generating courseware, and cost-effectiveness. [1] In this discussion we will examine four particular types of educational and information technology which appear promising as to their future potential, using some recent experience at Stanford University as a basis for projections from an admittedly cloudy crystal ball. Technology to be discussed include video tapes and cassettes, the video disk, computers, and the remote-access full-text library.

Videotapes and Cassettes

Recorded media has been used in education for a long time, particularly if we include audiotape and film, and can be effective in making good teaching and scarce resources available to student audiences that might not otherwise have access to them. The costs of producing such media can be high, however, particularly if scripting and other production aids are used together with editing to obtain a polished presentation, so that such productions are most appropriate where they can be used with large student populations and/or repeatedly where the material being presented is such that there is no problem of obsolescence. In many cases neither of these criteria are met with engineering education, particularly at the graduate level. Videotapes and cassettes are easier to produce and somewhat less costly than film, but since the major costs are in the production and not the media, the basic problem of cost-effectiveness remains. Furthermore, while televised instruction may be more effective than audio alone, by itself it has not been found to be significantly more effective than live classroom instruction and may be less so. [2,3]

Tutored Video Instruction

In the autumn of 1973 the Stanford School of Engineering started an experiment to determine the effectiveness of combining the use of unedited videotapes of live classes with a presentation of the tape to a small group of professional engineers in industry in the presence of a local mentor, or tutor, as a means for providing needed continuing graduate engineering instruction at remote sites in a cost-effective way. [1] Evaluation of the data obtained in this test suggested that the educational experience thus provided was equal to and in some cases superior to that in a large live class on campus. For example, Figure 1 compares the grades of the TVI students with those of the on-campus students and those receiving the same courses by live television (with audio talkback to the classroom). The 302 on-campus students achieved a grade point average (GPA) of 3.38 out of a possible 4.00, which is typical of Stanford graduate engineering students at the master's level. The local industrial students participating by live TV with audio talkback had a GPA of 3.19, still quite acceptable but below the on-campus students. The remote videotape students with local tutors, on the other hand, achieved a GPA of 3.67, an achievement which is made even more remarkable by the fact that several of the TVI students had marginal academic qualifications that would have made their admission to the Stanford Graduate program on campus unlikely. It may also be noted that the performance of the remote TVI students in

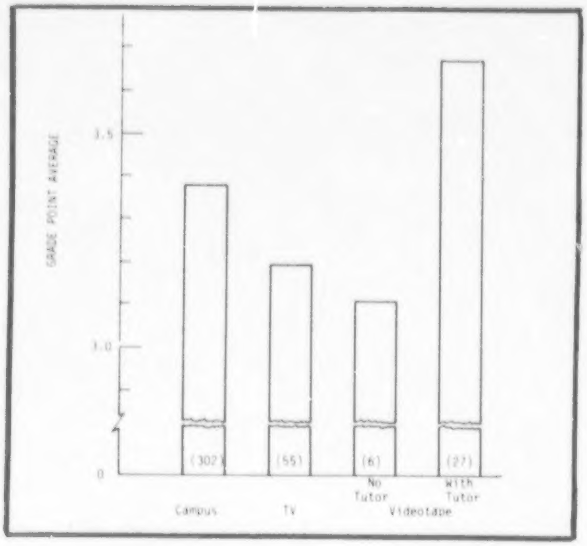

Fig. 1. Results of tutored video experiment

courses without local tutors was substantially below that of the other groups, although the data in this case was very limited. An examination of the performance data in terms of the qualifications of the students which would be considered for their admissions to a graduate program in shown in Fig. 2, from which it is seen that the students who would normally have been granted admission to Stanford did extremely well, outperforming their on-campus counterparts and in fact achieving results that were essentially independent of their backgrounds. The two students with the lowest qualifications did acceptable work (B or better) even though they would not have been admitted to the Stanford MSEE program based solely on their admissions data.

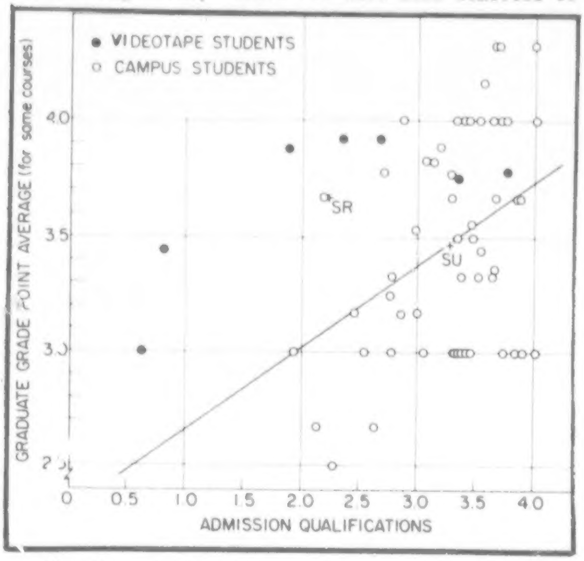

Fig. 2. Results of Tutored Video Experiment

Academic Credit. On the basis of the early favorable TVI results Stanford agreed to grant academic credit toward a graduate degree for the off-campus TVI work, with the understanding that the program would be carefully monitored as to the quality of the academic experience. The program has continued and while the number of matriculated TVI graduate students has been deliberately limited, the program now includes students from coast to coast. On the average the TVI students have continued to outperform the on-campus graduate students; through summer of 1978 a total of 218 courses have been taken by students admitted to the graduate program with an overall average GPA of 3.50, and if the assessment is limited to the 146 courses taken by students whose admissions qualifications were comparable to those of the on-campus students, their average GPA is 3.56. The demanding combination of full-time professional work and a graduate academic degree program and/or dissatisfaction with the TVI courseware or method have resulted in several students dropping out of the program, but as of this writing fourteen MSEE's have been granted in whole or in part based on the TVI work, and another seven are nearing completion of their degrees. A large number of TVI students have taken the same courses as Non-Registered Option students (taking the course on a graded basis without formal admission to the University) either in preparation for later graduate admission or to upgrade their skills with no desire for an additional degree.

TVI Program Assessment. The TVI program of graduate engineering instruction has continued to expand since its inception at Stanford in 1973 and appears to fulfill a definite need. While not inexpensive to the client organizations, it can in some cases be more satisfactory and less expensive than instituting an in-house educational program, particularly for a smaller organization. From the standpoint of the University the program is only possible because the marginal costs of producing unedited recordings of live classes are low and the program can be made to pay its own way. There is a growing trend for high technology industry to locate facilities away from urban centers where land and housing costs are high and where local opportunities for advanced graduate technical training may be limited; the availability of a program such as that of Stanford for TVI classes may be important as an inducement for attracting high caliber engineering talent. A discussion of the Stanford TVI program with suggestions for organization and management are given in a study prepared for the National Institute of Education. [4]

For the discussion here important things to note are that a format for using media (specifically video tapes and cassettes) has been demonstrated which can be educationally and cost effective, does not impose an undue burden on existing educational facilities, meets a need and is acceptable for providing education for engineers in industry, and seems destined to continue to be utilized on an expanding scale. A number of other universities have instituted similar programs, some patterned after the Stanford model, and more seem likely to follow. Based on the Stanford experience, several comments seem relevant:

1) A variety of videotape formats are becoming available, resulting largely from the efforts to introduce home video recording to the mass market. The incompatibility of these formats is unfortunate and it is hoped that an industry standard format will be chosen that educational institutions, at least, can agree upon.

2) A TVI program does impose an additional burden on the faculty; not so much in the classroom (except that the recording is most effective if teaching techniques are compatible with video), as in the needs for extra faculty time to deal with questions from TVI students, grading examinations, etc. Unless recognition of these demands result in suitable compensation (in money or compensatory time) faculty resistance and refusal to teach on TV can develop.

3) Academic credit toward a degree program seems to be an important incentive for some students. As more universities offer such courses, some mechanism for transferring credit between institutions may become increasingly important. What seems likely to happen is that courses that are particularly well taught or teachers that are especially effective and known will become more and more popular, independent of their institution, and will receive wide distribution, so that it will become less common for one institution to attempt to provide all courses but instead will concentrate on providing distribution for their star performers. If institutions do not cooperate in permitting students to selectively chose their courses with provision for transfer of credit, then independent educational entrepreneurs will probably preempt the continuing education field.

AMCEE

An example of the expanding use of media for continuing education is shown by the recent formation of the Association for Media-Based Continuing Education for Engineers, Inc, known as AMCEE. This is a non-profit consortium of nineteen universities and schools with headquarters at the Georgia Institute of Technology formed to offer courses from any of its member institutions on videotape anywhere in the world. The first AMCEE catalog for the period from June to December of 1978 listed 172 courses in a wide variety of engineering and related fields such as mathematics, business administration, etc. that were available on videotape or cassette from eleven member institutions. [5] Responding to this initial offering were orders from 18 clients for a total of 32 courses. The second AMCEE catalog for the first half of 1979 increased the offerings to 223 courses from 15 member institutions.

As presently organized AMCEE does not grade problem sets or examinations and gives no grade, certification or credit toward an academic degree, although these may be available from individual AMCEE member institutions for their own courses and, in some cases, by transfer from other institutions. There is also no particular emphasis in the AMCEE catalog on using the small interactive group structure with a local tutor that has been effective in the Stanford TVI program, although the AMCEE offerings are compatible with this format. The AMCEE program will provide an interesting opportunity for determining the acceptance of media-based engineering education and for examining those factors which seem important in providing educationally and cost effective educational services.

The Videodisc

A new media technology closely related in some ways to video tapes and cassettes discussed above is the videodisc in its several formats. This is a technology that has had some problems getting started, as suggested by a sampling of titles from the past several years: "Laser stylus plays back video discs on TV sets" (1/73); "Disco-vision study complete" (2/73); "The video disc: count on it" (3/74); "Videodiscs spotlighted at SMPTE meet" (6/74); "Developers of TV playback video discs begin demonstrations to stir up interest" (3/75); "Videodisc players offer good pictures and special features" (3/75); "The video disc looks ready for the consumer" (5/75); "TV on a silver platter" (8/75); "Videodiscs: the expensive race to be first" (9/75); "Videodiscs: $200 billion to see I Love Lucy, anytime" (2/77); "The imminent videodisc revolution" (4/77); "A jukebox platter with billions of tunes" (10/77); "Lack of software deters video disc introduction" (7/78) --- It has been quite a struggle, and the stakes (and the potential) are both very high. With the recent market availability of the Phillips/MCA videodisc system (in December, 1978) it appears that the revolution is ready to happen.

The videodisc comes in a variety of formats, [6] but in essence it can provide about 30 minutes (or 54,000 frames) of high quality color television with two channels of sound. Since it is played by reflected or transmitted light there is no degradation with repeated playing. The playback units are mechanically simpler than tape machines, (although required precision is high), and can offer random access, stopped, slow or fast forward or reverse playback without loss of synchronization. A very significant advantage over tape, aside from the longer life, is replication by pressing or photographic printing as a parallel process, rather than the serial recording required for each copy of a tape master.

Without question the videodisc could have important applications for engineering education. There is a question, however, whether (like interactive cable television) this promise may be delayed in its realization by marketing and manufacturing decisions. Here we will examine briefly two types of videodisc application to education; as a simple replacement for video tape and cassettes, and in the development of courseware to specifically take advantage of the random access and large data storage capacity of the disc.

Videodiscs as a Replacement for Videotape

There would be a number of advantages in using videodiscs as a simple replacement for videotapes and cassettes as they are now used for remote TVI instruction in programs such as that of the Stanford ITV network or that of AMCEE described above. The videodiscs are easier to copy and to handle, are better suited for mailing, potentially less costly, longer-lived, less subject to damage, and offer advantages of unlimited slow and still frame viewing.

It seems clear that replacement of videotape by the videodisc in present applications, however, will be restricted to those systems in which the cost of preparing the master disc is small, since the number of copies would be of the order of 10-100 or less. The cost of mastering the videodiscs which are reproduced by pressing is in the thousands of dollars, which would be prohibitively expensive for many present educational applications. The photographic videodisc technique, in which copies are simply printed from a transparent master which has been recorded directly by modulated laser light, appears to offer a low cost master [7] but at the present time the manufacturers using this technique do not plan to produce systems that are appropriate for the type of educational application discussed above. This situation may change, however.

Random-Access Videodisc Systems

A number of videodisc system developers see the random access capabilities and very large storage capacity of the videodisc as more promising for system application since these offer possibilities which do not compete with the videocassette market. For example, under microprocessor control, an educational module can be developed which allows branching and random access to adapt the presentation to the ability and interests of the student.

Experience with attempts to develop computer-aided instruction suggests that such educational applications can require extremely expensive courseware development, and may be appropriate only in special situations where the application can be widely used without danger of obsolescence. The random access disc playback units will also be considerably more expensive than a simple video reproduction unit.

It thus seems to me that while the videodisc clearly has considerable potential for educational application, the realization of this potential will require careful thought as to the appropriate applications. Proposed applications and hardware configurations which will require significant changes in teaching methodology and development of totally new approaches to courseware may take some time for acceptance. On the other hand, the growing acceptance of conventional video instruction using the TVI technique could benefit immediately from the videodisc technology if the appropriate hardware is made available, and may in the near term provide a more attractive market for disc manufacturers.

Computers Large and Small

A recent news item in the Stanford DAILY announced that a computer program to teach Armenian will begin next year if funds are available, using a combination of video display, coordinated recorded instruction, and computer synthesized speech. There is little doubt that rapid advances in the power, speed, and size of computers coupled with reductions in cost can have great impact on future engineering education, as they have already (e.g. the PLATO system). It seems clear that both large, time-shared computers and small personal computers will find particular applications. As in the case of recording media, the limitations seem to be more in the development of the courseware and the cost- effectiveness of the applications rather than in the capabilities of the technology.

Large Time-Shared Computers

The advantages of sharing a large data base and computing capacity suggest that large time-shared computers will continue to find application for engineering education as well as education in general. As in the case of teaching Armenian, the computer enables students to take a highly specialized course such as an exotic language that has a small demand and might not otherwise be available and to develop a one-to-one relationship with the "teacher". It can permit an engineering instructor to interact with a class via the computer in providing exercises that can be readily modified, use a common instructional program at the convenience of the student, and assist in grading. Such use is growing at Stanford and elsewhere.

LOTS. Two years ago most academic computing was removed from the large campus IBM 370/168 computer at Stanford and placed on a Low Overhead Time-Sharing system (called LOTS) having software that was especially appropriate for student and faculty use in courses with a minimum of supervision. The computer was available without charge for academic use, although ultimately connect time and disc storage space limitations based on course requirements were imposed.

The history of LOTS at Stanford illustrates a point about academic computing. When installed in 1/77 LOTS used a DEC 20/40 computer with 31 terminal ports, 128 kilobytes of core memory and 200 megabytes of disc memory. In February core was doubled to 256K. In March the number of ports was increased to 48. In May the speed was doubled by installation of a DEC 20/50, there were long queues waiting for terminal access and students were using the computer around the clock. In October at the start of the 1977-78 academic year core memory was again doubled to 512K and disc capacity tripled to 600MB. The number of ports was increased to 64 in November and again to 80 in February of 1978. In April a time limit of two hours per week per course unit (maximum) was imposed. In December core memory was again doubled to 1024K and in March 1979 is scheduled the installation of a larger machine, a DEC 20/60. When cost of computing is low and the software is relatively easy to use as in the case of LOTS, it would seem that the utilization will increase with no end in sight, being limited only by the frustration level of waiting for access, reponse, or storage space.

By no means all Stanford students use LOTS, nor all courses. Much can be done to make the software more forgiving and easier to use by the novice or occasional user. As demand grows time-shared computers will get larger and more powerful, and networking will increase to permit sharing of academic resources and unique systems. It seems clear that large time-shared computers such as LOTS will play an increasingly important role in not only engineering, but education in general.

Prestel/Viewdata. Another recent development involving time-shared computers and telecommunications that may have important implications for education is the public information service that was initiated in England last September, first called Viewdata and now known as Prestel. This is an activity of the British Post Office, involving user television sets equipped to display color graphics and characters for interaction by telephone from the user's home or office with a many pages of information stored in a central computer by a large set of Information Providers (IP). The Post Office essentially rents computer storage space to the IP's who select any content they think will be of interest to the users and for which the user is willing to pay; news services; travel information, consumer advice, games, business information, educational materials, etc... as of November over 150 IP's had contracted to provide over 180,000 frames of information to users in London, Norwich and Birmingham, with considerable expansion scheduled for this year.

Prestel thus potentially provides a mechanism by which any information or education entrepreneur can provide a service which can be supported by small user access charges, limited only by the imagination of the IP. It should be of great interest to see if this service can succeed financially.

Personal Computers

The insatiable appetite for computation services coupled with the rapid development of inexpensive and powerful microprocessors promises an explosion of small special purpose computers and interactive devices. Education is an obvious application. As one example I would like to mention the spelling device introduced recently by Texas Instruments called Speak and Spell (tm). This is more than a toy, though it is designed for use by children (and loved by adults as well). In a small hand-held device looking like a portable radio with an alphabetic keyboard and a small visual display, four integrated circuits provide a sophisticated voice synthesizer and a vocabulary of 200 easily-misspelled words to play several word games with the user, giving visual and spoken feedback as letters are pressed and words formed, keeping score and giving the user an appropriate pat on the back when words are spelled correctly. The device sold for about $50 before Christmas and stores could not keep it in stock; children love it and adults can hardly put it down. As a teacher sometimes dismayed by spelling errors of college students, I can only be enthusiastic about the effect that such "toys" can have on spelling ability. There are plans to add modules for increasing the vocabulary, teaching foreign languages, adding other games, etc... the possibilities are fabulous.

Such devices will certainly not be limited to word games and spelling. The educational applicatons are limited only by the imagination of the educators. More than that, however, they can introduce some much-needed fun into the educational process. As George Leonard urged in EDUCATION AND ECSTASY in the 60's, education should be an ecstatic experience, and use of individualized programs made possible by computers, large and small, can help to make it so.

The Remote Access Library

As a final look into the cloudy crystal ball at uses of technology in engineering education, I would like to briefly discuss remote access to the full text of published information stored in large archives or libraries. We are swamped by published information: the number of publications grows; the increasing costs of publishing restrict library acquisitions; reprographic technology and the new copyright law make adversaries of publishers on one hand and librarians and users on the other; we have computers that provide rapid access to bibliographic citations that can be only frustrating when the cited materials are not easily available... The situation has been bad since Vannevar Bush proposed his MEMEX in 1945[8] and has grown steadily worse since.

It might be supposed that the increasing power and size of computers would allow all information archives to be stored in on-line memory for instant access in the near future. This would have the advantage of permitting searching and processing on words or phrases, editing and manipulation. This may happen as breakthroughs are made in memory technology, but to me it does not seem likely in the immediate future for several reasons: 1) the sheer size of the existing information archive; 2) the costs of converting existing archives to digital form, OCR notwithstanding; and 3) the tendency for use of computers to generate more paper, not less, as information manipulation becomes easier.

It is hard to imagine how our working, teaching, and learning activities might change if we could have a convenient terminal in our home or office with immediate access to the full text of essentially all of the significant world archives of information. Many people, when asked to picture this, say that they already have access to more information than they can use and do not need more. I think they are mistaken; much of our world of information is redundant or superceded, and it is partly due to difficulty in access that it is not eliminated or condensed. In a sense it is like anticipating the effect of the automobile, the telephone, xerography or the computer before these things existed; it is just not possible to predict the consequences.

I would like to suggest that not only would the impact of such access on engineering education be profound, but that in large measure it is technically feasible today. A method that could be employed is similar to that explored by INTREX at MIT in the 60's and more recently attempted by the New York Times information bank, [9,10] with certain small modifications. The basic scheme is shown in Fig. 3 and consists of a combination of storage of images of full text documents on microfiche in manually accessed filing cabinets, a user-controlled device for transmitting high resolution images of requested documents over a time-shared video channel to the user, and an image-storage viewing user terminal. I believe that such a system could be assembled with available technology, and a preliminary look at the economics suggests that it could be made self supporting by user fees approximately equal to those now paid for xerographic copies, including a royalty fee to the author or publisher for every accessed image. Think of a library where no document is unavailable because it has been checked out, misfiled or vandalized; with essentially unlimited capacity, with document availability within minutes of an initial request and pages turned or randomly accessed under your control within a second or less. It could happen, and soon.

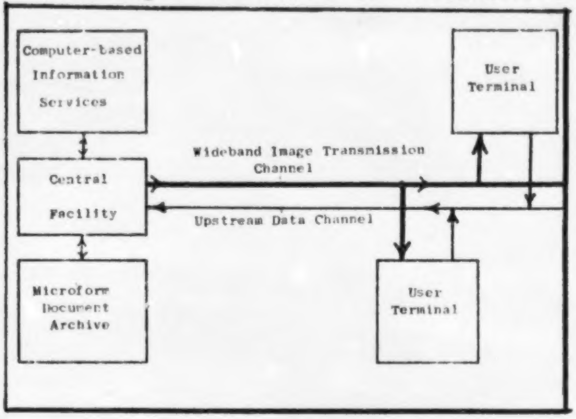
Computer-based Information Services
Central Facility
Microform Document Archive
User Terminal
User Terminal
Wideband Image Transmission Channel
Upstream Data Channel

Fig 3. Remote access full text information system

Conclusion

In this paper I have briefly discussed four ways in which educational technology now is or soon will affect engineering education. Repeatedly it seems clear that limitations are not in technological capabilities; rather, it is developing courseware and institutional arrangements appropriate to the capabilities of the technology and the needs of the various parties involved. It seems of prime importance to keep the educational objectives in mind, and not be fascinated by the technology. Cost effectiveness is also a prime concern; engineering education needs to accomplish better education with less money. Carefully used with these cautions in mind, educational technology can be of great assistence in engineering education of the future.

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WILLIAM R. KINCHELOE JR.

Wm. R. (Bob) Kincheloe Jr. received the BSEE and SBEE from the Univ. of Oklahoma and MIT in 1946 and 1947, resp. Following three years as electronics officer in the U.S. Navy he completed graduate work in EE at Stanford University, receiving the PhD in 1962. In 1951 he joined the Stanford Electronics Labs, becoming a Senior Research Engineer in 1962. At SEL he has worked with and led projects in signal processing and communication systems, ranging from audio to microwaves. He has taught courses in EE and dealing with societal impacts of technology at Stanford since 1958, becoming an Adjunct Professor in 1975. Since 1969 he has helped design, taught over, and has been a technical adviser to the Instructional Television Network of the Stanford School of Engineering. Since 1973 he has coordinated a program of the Stanford ITV Network which provides continuing education to engineers in industry using tutored video instruction.

A BILINGUAL VIDEOTAPED TECHNICAL TRAINING PROGRAM

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Cleveland, Ohio

In the summer of 1973, the Instructional Television Network classrooms at Case Western Reserve University were used to produce a 45-hour bilingual (Russian-English) videotaped technical training program. This unusual product was the outcome of using flexible videotaping facilities to meet a demanding set of instructional requirements.

The instructional requirements for this program were specified in a contract between Soviet agencies and C-E Cast (the C-E Cast Equipment Division of W.S.Tyler Inc., a subsidiary of Combustion Engineering Corp.) for delivery of seven automatic molding lines to the KamAZ complex. The contract called for both classroom instruction and hands-on training of Soviet engineers and technicians at the C-E Cast assembly plant in Mentor, Ohio, prior to shipment of the first molding line.

The instructional resources available to meet these requirements can best be understood by first describing the molding lines themselves. The lines at KamAZ are used for sand casting engine blocks and other automotive parts for 12 different truck and tractor models. Each automatic molding line is a huge machine, approximately 200 feet in length, composed of mechanical, pneumatic, hydraulic, electrical and electronic sub-systems. The hundreds of devices comprising these lines range in size from plug-in solid state logic modules which can be held in the hand, up to five-ton induction furnaces, each supplying molten metal to two automatic pouring stations. Users must learn the principles, operation and maintenance of electric and air motors, hydraulic valves, clutches, bearings, shock absorbers, solenoids, and other components. C-E Cast buys these components from more than 20 manufacturers, and the training of C-E Cast's customers has traditionally been supplied by these manufacturers.

Thus it happens that the media employed and the modes of training used by C-E Cast and its suppliers run the full range: instructional materials related to molding line components include slide sets (both with and without magnetic tape narration and slide advance pulses), tape-driven film strips, 16mm movies, videotapes, mock-ups and working models, together with collections of photos, drawings, diagrams, catalogs, manuals, and other printed material. Few of these packages can be used by themselves: in almost all cases these materials are used as part of a live presentation, intended to illustrate the content of a classroom lecture.

To simplify the administration of the training to the Soviet visitors required that the materials available in the many different media be converted to a single medium. The contract required that the spoken word be translated into Russian. In addition, the need for extensive display of motion -- moving parts, hands-on demonstration by the instructor, "animated" diagrams, etc.-- suggested that the entire package should be done in either motion picture or videotape. C-E Cast subcontracted with Case Western Reserve University for this work, because of our experience in producing instructional materials in various media.

The time and cost factors associated with movie production made it impossible to use. However, even the traditional methods of studio videotaping would have required more than the six months which we were given to complete the package. Thus we elected instead to use our Instructional Television Network facilities in a "candid classroom" mode.

Classroom videotaping facilities are becoming a more common feature of institutions of higher education in the U.S.A. Seventeen of the organizations which run these campus facilities have formed a consortium (named AMCEE -- Association for Media-based Continuing Education for Engineers) which sponsored a Pre-Conference Workshop here on Tuesday afternoon. The classroom videotaping facilities at Case Western Reserve University include three remotely-controlled black-and-white cameras, which allow the operator to tape whatever the instructor does, together with any visual materials or objects he may use.

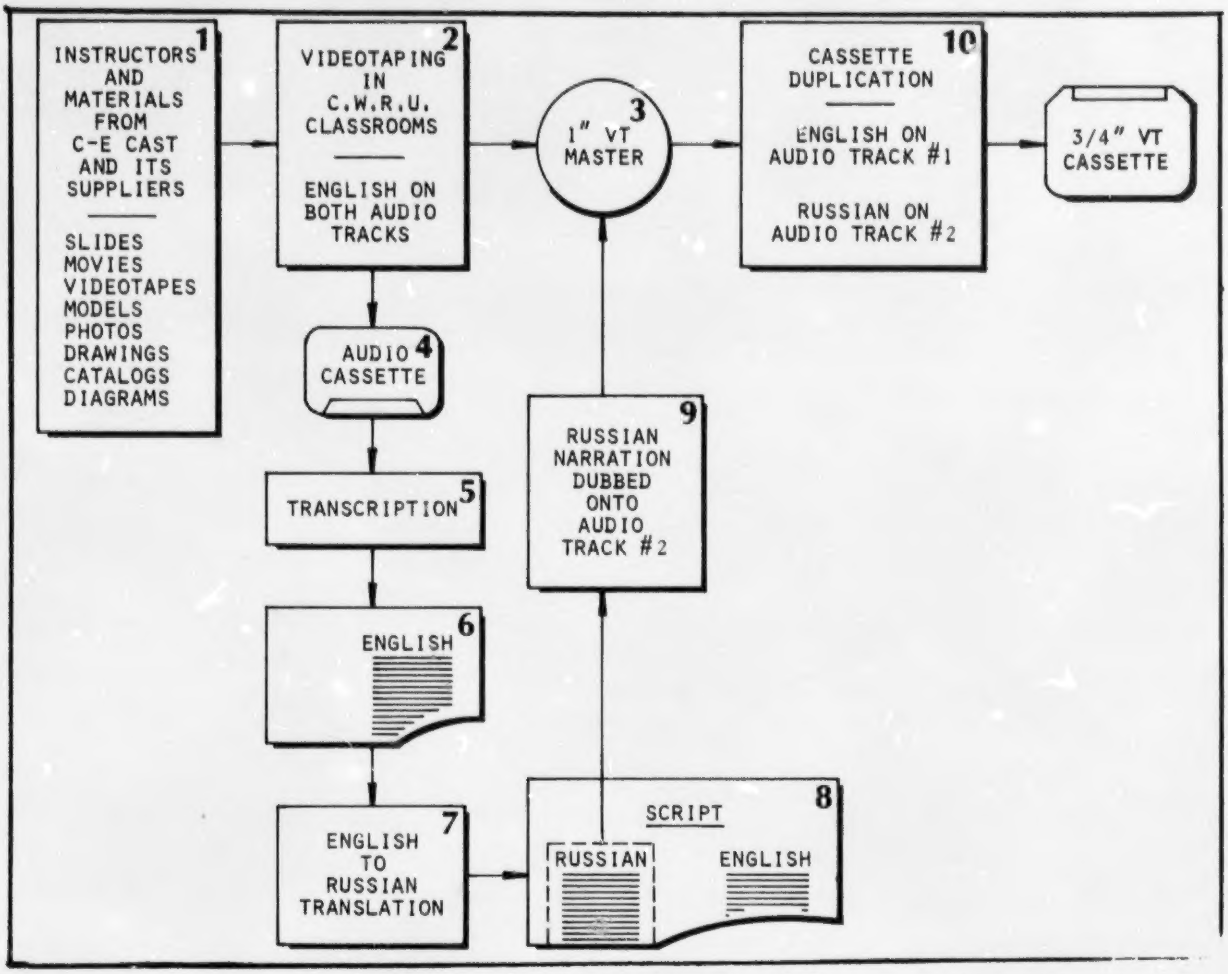
1
INSTRUCTORS AND MATERIALS FROM C-E CAST AND ITS SUPPLIERS
SLIDES
MOVIES
VIDEOTAPES
MODELS
PHOTOS
DRAWINGS
CATALOGS
DIAGRAMS
2
VIDEOTAPING IN C.W.R.U. CLASSROOMS
ENGLISH ON BOTH AUDIO TRACKS
3
1" VT MASTER
4
AUDIO CASSETTE
5
TRANSCRIPTION
6
ENGLISH
7
ENGLISH TO RUSSIAN TRANSLATION
8
SCRIPT
RUSSIAN
ENGLISH
9
RUSSIAN NARRATION DUBBED ONTO AUDIO TRACK #2
10
CASSETTE DUPLICATION
ENGLISH ON AUDIO TRACK #1
RUSSIAN ON AUDIO TRACK #2
3/4" VT CASSETTE

FIGURE 1. BILINGUAL VIDEOTAPING PROCESS

The approach we used to meet C-E Cast's requirements was to bring the 29 different instructors -- from C-E Cast and 19 of its suppliers -- into class-rooms, where we taped the presentation of each one. The process through which each presentation went can be illustrated in Figure 1. Box [1] identifies the instructors and the materials they brought with them for inclusion in their videotapes. We recorded [2] a 1" reel-to-reel master videotape [3] which, of course, had the instructor's English narration on both audio tracks. At the same time, we made a compact cassette recording [4] of his narration, which was sent to a typing pool for transcription [5]. The output was the English type- script of the narration [6], which was then translated into Russian [7]. The translators produced the correlative Russian translation of the English [8], which was then dubbed [9] onto track 2 of the videotape. This tape then became the master from which copies were duplicated [10] as required.

Clearly, with the master tapes and original (English) scripts in hand, translation of the tapes into any other language can be done by repeating steps [7], [8], and [9] of the production process as described above.

Some statistics of the project may be of interest: 85 videotapes, totalling 45 hours of student viewing, were completed between June 1 and August 28, 1973. The tapes ran from 10 to 59 minutes in length, averaging about 32 minutes. We logged an average of 4.5 hours of "studio" time for each hour of tape produced. The cost to C-E Cast of just the videotaping -- the translation effort was subcontracted separately -- came to slightly more than $1000 per product-hour. The tapes were first used in the Spring of 1974 for the training of visiting Soviet engineers and technicians at the C-E Cast assembly site. Tape sets have been shipped to the KamAZ complex. C-E Cast executives returning from KamAZ report that the videotapes are in constant use, fulfilling the use for which they were intended.

JAMES L. ROGERS

Jim is Director of the Instructional Television Network at Case Western Reserve University, where he also holds an Associate Professorship in the Department of Systems Engineering, Computer Engineering and Information Sciences. He received the BA and MA degrees from the University of Michigan, and the Ph.D. from CWRU.

Prior to joining the faculty at CWRU in 1972, Jim held positions in research, product planning and systems documentation with Burroughs, Xerox, and RCA. He is a member of ASEE, ASTD, AERA, and ACM. He serves as an AMCEE Director, and as a member of the AMCEE Materials Production and Utilization Committee.

SATELLITES FOR INTERNATIONAL CONTINUING ENGINEERING EDUCATION

Kenneth S. Down
Assistant Dean and Director
Stanford Instructional Television Network
Stanford University
Stanford, California

SUMMARY

Engineering educators in the United States are considered pioneers in using media-based systems (primarily television) to provide educational programs for their employed professional constituents. They have found television courses to be effective in terms of learning, accessibility, convenience and cost. The availability of international communications satellites has caused these educators to begin exploring the servicing of engineers and scientists worldwide with media-based educational programs via satellite. This paper outlines some of the possibilities for this service.

The Present Situation

Systems operating today fall into two major categories: 1) live transmission of courses from classrooms to companies over Instructional Television Fixed Service (ITFS) channels or over Educational Television (ETV) channels and 2) videotapes of either live or studio produced instruction.

An ITFS signal has a broadcast range of about 30 miles. In areas such as Los Angeles or San Francisco, ITFS works well. Many high technology firms are located within range of the University of Southern California and Stanford University systems. However, in Colorado the terrain is such that live broadcast is impractical so Colorado State University has built its off-campus program around a videotape distribution service. M.I.T., whose program is based primarily on a catalog of studio produced engineering and science courses, depends on mail and parcel delivery services for distribution of its programs worldwide. Demand for certain M.I.T.'s packaged courses is so great that, in one case, 20 complete sets of 21 tapes each are required to meet circulation demands. That alone represents an inventory investment of $15-20,000. The recently begun Tutored Videotape Instruction program at Stanford permits students at locations outside broadcast range to earn degree credit by viewing videotapes of Stanford lectures.[1] Company provided tutors assist in the absence of the course instructors. The most troublesome aspect of that program is the slow delivery of tapes to the students and homework and examinations to the professors. A minimum of one week lag time must be built in to insure stability in the viewing schedules at the remote sites.

The systems, while effective in reaching the producing universities' well defined constituencies, are generally unable to expand their services for the following reasons: (1) the signal can only travel a short distance for a reasonable cost; (2) the mail and other delivery services are slow; (3) videotape inventory is expensive.

SATELLITE CAPABILITIES

Problems of limited broadcast range or slow videotape delivery in the United States are magnified in serving engineers with televised instruction in foreign countries. However, a communications satellite which is placed in synchronous orbit at an altitude of 37,780 Km (22,240 miles) can provide broadcast coverage over about one-third of the earth's surface. This permits expansion of voice, data and television services from regional to national or international coverage.

INTELSAT, the International Telecommunications Satellite Organization, is the body that owns, maintains and operates the global satellite system which is used by countries around the world for public international telecommunications services. As of March 31, 1978, membership in INTELSAT numbered 101 countries.[2]

Earth stations in the global system are owned and operated by domestic telecommunications entities with the countries that hold membership. The stations process all forms of long distance communications. Thousands of telephone calls, telegraph messages, high-speed data, facsimile and television signals are transmitted and received at the same time. The flexibility of the system permits instantaneous communications between any station and another or among many stations simultaneously. Nearly 90% of the total utilization of the INTELSAT system is for voice circuits, the remaining 10% utilization covers all other services, including television.

Use of the INTELSAT system for satellite television transmission largely reflects interest generated by individual news and sports events

International events such as the Olympics, Papal Masses, and pilgrimages to Mecca generate substantial international television coverage. Algeria, Malaysia, Nigeria and Sudan utilize INTELSAT facilities for domestic television transmission. Each INTELSAT IV-A has a nominal capacity of 6,000 voice circuits and two television channels. This leads to extremely high tariffs for use of the presently limited TV channels.

COST FACTORS

Pricing is based on tariffs set by the sending and receiving countries. For instance, the current rate for TV transmission from the United States to Brazil is composed of the United States COMSAT rate of about $1,600/hour plus the Brazilian EMBRATEL rate of about $2,600/hour, for a total of about $4,200/hour.[3] That does not include the charges for getting the signal from the point of origin to the INTELSAT uplink earth station and from the INTELSAT downlink earth station to the destination point. Presently, unless there are large numbers of participants in a given program, the cost per viewer for TV transmission is prohibitive.

PROPOSED ACTIVITIES

INTELSAT is, at this writing, evaluating its service offering capability and tariff structure. Should a policy and set of procedures be adopted which encourage TV transmission of education programs, the delivery of engineering courses via satellite may become a viable option. Three options, (1) broadcasting of special seminars; (2) occasional teleconferencing; and (3) internally distributing media-based material via domestic satellite systems appear reasonably attractive in the near term.

Special Seminars

Suppose, for instance, that the international authority on irrigation water management resides at an American university; and that this authority has developed a special one hour state-of-the-art lecture on recent developments in that field. A live video transmission with audio talkback could provide a very stimulating educational opportunity for irrigation engineers and students in several countries simultaneously. In this case, several hundred people would be participating, thus reducing the cost to about $50 per viewer hour (assume cost of $15,000 for video to three countries with audio talkback. Then, $15,000/300 viewers = $50 viewer hour).

Teleconferences

Another model might be a two or three-way teleconference among engineers, scientists or high-level planners separated by large distances. This might follow the method employed in a two day telecolloquium held in 1977 between the University of Montreal and Stanford University. Discussions were focused on the social applications of international satellites. In this particular case, two panels of experts conducted a two-way, face-to-face-video, bilingual meeting using prepared statements supplemented by heavy audiences participation. When asked to rate the system regarding its suitability for different types of exchanges, participants ordered them as follows:[4]

Exchanging opinions(most satisfactory)
Asking questions
Receiving/giving information
Generating ideas
Making decisions
Discussing controversial issues
Resolving disagreements (unsatisfactory)

Domestic Satellite Distribution

In its planning for expanding internationally, AMCEE is keenly aware of the need to work cooperatively with foreign universities in a partnership arrangement. American and foreign universities might work jointly on a program which would be produced on videotape at the United States, and/or the foreign partner's campus. The foreign university would work with its domestic communications system to arrange for national distribution via its domestic satellite system or by any other appropriate method (terrestrial television, mail, etc.).

BANDWIDTH FACTORS

While most discussions focus on television transmission, the use of narrower bandwidth options on satellites should not be overlooked. In lieu of full bandwidth teleconferences, one might also consider use of two-way coupled with high-speed data and facsimile capabilities. Computing and problem solving sessions could be conducted using these services where the course instructor might receive transmission of problems via a facsimile or computer system.

The Stanford University, California and Carleton University, Ottawa, curriculum-sharing experiment using the joint American-Canadian Communications Technology Satellite (CTS) confirmed that a novel digital video compression technique could be used effectively in transmitting engineering courses via satellite.[5] Through this technique, a signal, rated satisfactory by the students involved, was transmitted using about one-eighth the normal television bandwidth. While the processing equipment needed at both ends of the system was very expensive, the limited production of only a few models could not provide any manufacturing economy. Should this technique receive wider acceptance by satellite technologists, the cost of video compression equipment would be expected to be reduced. This should lead to more viable pricing of television channels on satellites.

CONCLUSION

Presently, the broad-scale use of satellites for international engineering education does not look promising. Should INTELSAT and its member nations reduce the high hourly charge for use of TV capability, the distribution of short or full-length engineering courses may become a practical option. In situations where large audiences can be aggregated for a single special event, such as a major technical address, the likelihood of live international participation could be increased. Use of domestic communications satellite systems in foreign countries for distribution of packaged materials (videotapes) seems to be a distinct possibility. Teleconferencing on important issues with large scale audience participation might also be a practical option. Use of narrowband communications features of satellites will probably receive the attention of several experimentors. As technologists develop ways that television signals can be transmitted via satellite using less bandwidth, cost may become a less significant factor.

Engineering educators must continue to develop plans for international continuing engineering education using satellites. Experiments should be conducted and thoroughly documented in preparation for the day when satellite distribution will be a practical option.

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KENNETH S. DOWN

Kenneth S. Down has served as Director of the Stanford Instructional Television Network since 1969. He is particularly interested in the efficient and effective delivery of graduate engineering and science education to employed engineers and scientists, both for degree credit and continuing education purposes. Having served as a consultant to university media-based system planners, he serves on the board of directors of the Association for Media-based Continuing Education for Engineers (AMCEE). His publications include: (with Gibbons and Kincheloe) "Tutored Videotape Instruction: A New Use of Electronics Media in Education." Science 195(1977).1139. "The Stanford Instructional Television Network." Educational Media Yearbook 1978, New York, N.Y., R.R. Bowker Co. He holds an M.B.A. degree from the University of Santa Clara, having received a B.A. degree in Economics from Stanford University.

MODERN INFORMATION SERVICES FOR WORLD-WIDE CONTINUING EDUCATION

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Summary

A modern educational information service is described which will enable decision makers at their job site to match the continuing education needs of practicing engineers with available learning resources. Operations are scheduled to begin in the fall, 1979. Background, system operation, and evaluation plans are briefly outlined herein. The information service is sponsored by the Association for Media-based Continuing Education for Engineers (AMCEE) as part of its effort to increase the national effectiveness in continuing education of engineers.

The purpose of this paper is to stimulate discussion of how the operations might be extended to engineers and managers worldwide.

Background

Industry and government are acutely aware of their key human resources and the need to maintain and enhance the technical vitality of these people. Encouraging education on the job is virtually always "company policy," and occasionally education is practiced with formal, in-plant programs of excellent intellectual merit. But more often, an array of educational opportunities are unavailable, thus good intentions with firm budget commitments go underutilized. In this context, the proposed information service is needed and should be welcomed and utilized.

The Engineers Joint Council of New York published a compilation of short courses (not media-based packages) for several years. Learning Resources was a publication issued three times a year by the Engineers Joint Council, New York City. It was "a compilation of essential information about short courses, seminars, conferences, workshops and other educational activities (but not learning packages) through which engineers, educators, scientists and managers may enhance their professional competence." Unfortunately, this EJC publication ceased operations in 1977, leaving a void. Interestingly enough, at the time of its demise the publication had over 400 subscribers and a total of 800-1000 copies of each issue were sold. Rising costs in New York City, problems of currency with only three issues a year, and lack of technical staff to cross-reference and key-word the entries properly were among the reasons Learning Resources ceased publication.

An indication of the scope of the major continuing engineering educational operations which needs to be cataloged can be gleaned from recent surveys. A study, Education in Industry,[1] conducted by the Conference Board, a New York based research organization, estimates that the nation's largest firms are spending more than $2 billion a year on employee education. The report was based on data provided by 610 companies with 500 or more employees. It reported that programs to train and instruct new employees account for a substantial portion of some firms' education spending; but most companies give top priority to present employees in an effort to prepare them to assume new responsibilities, improve their performance in current jobs, and maintain their competence in the face of changing knowledge and technology.

> Among the 32 million or so persons employed by firms with 500 or more employees, about 3.7 million, or 11 percent, took part in in-house courses provided by their companies during working hours, and another 700,000 (or 2 percent) were enrolled in company courses given during nonworking hours. Participation rates are usually higher among exempt than among non-exempt employees. One corporate giant offers a "back of the envelope" estimate that about

> a quarter of its professional and managerial employees have taken part in an "off-the-job learning experience of at least two days" during each of recent years. The study did not attempt to measure participation in tuition-aid programs directly, but by relating its findings about their prevalence to the evidence of an earlier study that about four percent of the employees of companies having such programs took part in them during a one-year period, an estimate of 1.3 million employee participants is derived.
>
> Direct expenditures are projected to have been about $2 billion in the "past year." About 11 percent of this total is accounted for by tuition-aid programs and 9 percent by outside courses pursued by employees during work hours or otherwise "in the line of duty." The remaining 80 percent represents direct costs incurred for in-house company education and training activities.[1]

One final note from Education in Industry gives some perspective to this massive effort, because it underpins the great diversity of offerings and sources which serve the field.

> "A basic precept at our company is that if something can be obtained from existing sources we don't do it ourselves," one corporate education executive states. While most managers would add an "other-things-being equal" qualifier, it is a fact three-quarters (74 percent) of the companies surveyed - the proportion varying by company size and type - send some of their employees to take courses or seminars at outside education-training resources during working hours or otherwise "in the line of duty."[1]

The core listing of today's resources available for continuing education of engineers is short courses offered by universities, technical societies, trade associations and proprietary firms. These courses are designed specifically for the practicing engineer. Typically, the course is an intensive effort, one to five consecutive days. Most programs draw their students nationally, or at least from a broad regional, to support the diversity and specialization required. Almost without exception, the short courses are publicized by direct mail to the individual engineers who are on specialized mailing lists maintained by the technical societies and trade publications.

Klus and Jones[2] surveyed U.S. universities and professional/technical associations to determine their continuing education, short course offerings and how these programs are planned, course content established and evaluations conducted. A summary table from this 1976 survey indicates the scope of the noncredit activities that year.

Table I

Total Noncredit Activities Reported[2]

	Number With Activities	Number of Activities	Enroll-ments	CEU's
University	92	3,514	114,688	338,123
Prof./Tech. Assoc.	55	1,295	71,904	107,915
Total	147	4,809	186,592	446,098

Klus and Jones[2] extended these data to make an estimate of total annual enrollments in noncredit continuing education of engineers, about 270,000. with a total direct cost in tuition of about $41 million.

Another major source of continuing education is the enrollment of part-time students in regular university programs. The courses usually extend over 33 to 45 hours of instruction and may or may not be taken for academic credit. Night schools or extension offerings are the traditional way to obtain this kind of instruction. By one estimate, as many as 26,000 engineers participate in such programs in nearby universities almost always with tuition refund from his or her employer. Since these offerings are by design very regional in nature, no attempt will be made to catalog them.

A rapidly growing segment of the continuing education market is media-based. These courses are generally taken by small groups of engineers on a regular schedule at their job sites. This activity is reviewed in depth in companion papers.[3,4,5]

System Operation

> "Knowledge is of two kinds.
> We know a subject ourselves, or
> we know where we can find information
> upon it." Samuel Johnson (1775)

The initial activity and perhaps the keystone activity, to be undertaken is the collection of data from all universities, firms, professional societies and government agencies which offer continuing education courses for engineers and engineering managers. Both "live" short courses and media-based "packaged" courses will be included so long as they are intended for practicing engineers. The diversity and number of the basic information sources will make data collection and maintenance difficult. The basic information sources include the following types of institutions: universities (both academic and extension divisions); technical societies; trade associations; industrial firms; proprietary firms; video-publishing houses, and, state and federal government agencies. Well over 175 sources of courseware have been identified to date for inclusion in the survey. The initial collection of information is expected to exceed 3000 short courses scheduled within six months of data gathering, and over 200 media-based packages.

Each course description may have detailed information of 100-5000 words. Up to 40,000 records are involved, because most media-based packages are modular and are, therefore, described on an individual lecture basis. The information collection process will be an year around activity insofar as practical.

The data collection will be maintained on a modern word processing machine. Therefore, the information can be retrieved by means of key word indexes through a computer search initiated by an operator at a keyboard. Initially, this machine and direct access to the memory will be restricted to an operator in Columbia, South Carolina. Dr. Joseph Biedenbach and his staff at the University of South Carolina will develop the information service and will maintain all records. Thus, during its first year of operation, an external inquiry by telephone will be answered by the system operator in Columbia in much the same manner that airline flight reservations are handled now by telephone.

The telephone inquiry service is intended to add timeliness to a basic information service which will be provided to subscribers in the form of a biannual publication. The word processor will be used to prepare camera-ready copy with various cross indexes.

The business plan calls for the users of the information service to pay an annual subscription fee. The people who supply the data concerning courses will not be charged a fee. Directories are often marginal operations financially, but we are hopeful that the recent growth in continuing education activities can sustain the project eventually.

Service is scheduled to begin in the fall, 1979.

Evaluation

We will take maximum advantage of the prior experience and detailed knowledge of others as we plan the data collection. For example, Ms. Julie Gibouleau, former editor of Learning Resources, will be employed as a consultant to this project for several days in the first two months. Her knowledge of data sources and gathering procedures and other information will give the new service the benefit of her prior experience.

A Project Management Board (PMB) meeting is planned during this initial two month period to review the data collection operations plan in detail. Several members of the PMB, who have agreed to serve, have considerable experience in this area. These men are:

> Harold I. Abramson, Assistant Secretary for Continuing Education, Amercan Institute of Chemical Engineers, New York; A.I.Ch.E. has the most successful program of short courses offered nationally of all the technical societies.
>
> Lionel V. Baldwin, Dean, College of Engineering, Colorado State University, Fort Collins, Colorado; currently Chairman of the Board of Directors, Association for Media-based Continuing Education for Engineers.
>
> John W. Enell, Vice President for Research, American Management Associations, New York; the new AMA publication International Directory of Management Programs was prepared under his supervision.
>
> Peter Lykos, Professor of Chemistry, Illinois Institute of Technology, Chicago, Illinois; special interests include computer applications in higher education, chairing NAS-NRC a and ACS standing committees in this area.
>
> Morris E. Nicholson, Jr., Director, Continuing Education in Engineering and Science, University of Minnesota, Minneapolis, Minnesota; Chairman of Education Committee, American Metallurgical Society, and member representative to AMCEE.

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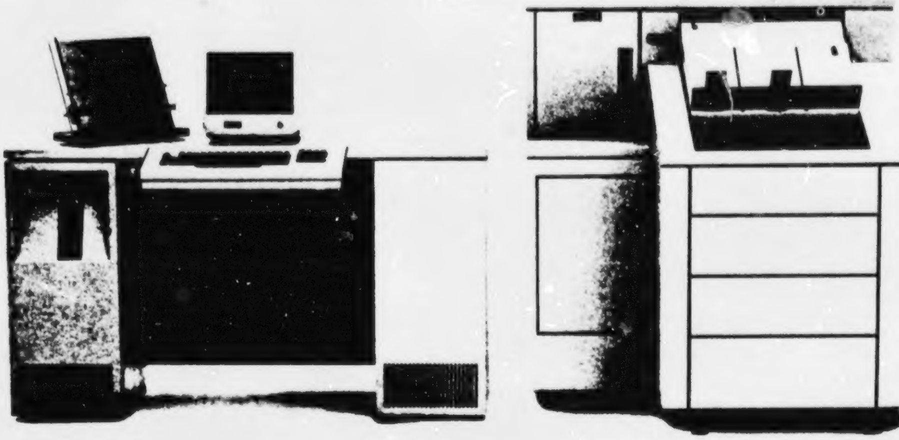
OFFICE SYSTEM 6
6/440 INFORMATION PROCESSOR



The IBM 6/440 Information Processor consists of an operator station designed for advanced record and text processing, coupled with a quiet, high-speed, high quality ink jet document printer.

Information is entered into the IBM 6/440 processor directly through the display/keyboard, or from prerecorded high-density (274,000-character) magnetic storage diskettes.

The unit's built-in logic and memory make it ideal for record processing. With it, you build files electronically. Update them quickly. Sequence and qualify them to create, on demand, vital reports and other documents.

Its display screen, memory and advanced text processing features provide needed capabilities for lengthy revision of text and for document assembly.

Prompting display

Built-in prompts on the system's functional display screen make the IBM 6/440 easy to operate. A simple option selection routine guides operators through revising, formatting and printing. Frequently used formats can be stored, visually checked and printed automatically.

Diskette reader/recorder

The 6/440 Information Processor provides economical storage of documents, records and other material on 274,000-character diskettes—with fast access for processing and printing.

Quiet ink jet printer

Its ink jet printer delivers high quality hard copy printing at up to 92 characters per second. And speeds the flow of information by permitting simultaneous printing and revision of documents, and by automatically feeding, printing and stacking letters and envelopes.

Office System 6: an advanced management resource

Office System 6 provides today's businesses and organizations with a vitally needed capability for administrative record processing. Increased function and power for text processing. Plus an optional communications capability.

Specifications

Power Requirements: operates on 115 volt, 60 hertz, 15 amperes, dedicated line. Normal current drain is 11.1 amperes. (Machines with volatile memories are subject to loss of buffered information in case of unexpected power interruptions. A machine connected to a dedicated circuit is less likely to experience unexpected power interruptions caused by momentary overloads.)
Maximum BTU/Hour: 4,632.
Environmental Limits: temperature 60°-90° F, 15.6°-32.2° C, relative humidity 8-80%.
Dimensions: Operator Station—41.0 in. (1,041 mm) wide, 23.25 in. (591 mm) deep, 29.0 in. (737 mm) high. Printer—41.12 in. (1,044 mm) wide, 29.5 in. (749 mm) deep, 44.5 in. (1,130 mm) high.
Operating Speed: up to 92 characters per second.
Paper Capacity: approximately 1,200 sheets 20 lb. (75 gm/m²) weight.
Paper Sizes: all standard cut sheet sizes not less than 7.0 in. (178 mm) wide or 10.5 in. (267 mm) long and not greater than 14.0 in. (356 mm) wide or long.
Paper Weights: 16 lb. (60 gm/m²) through 24 lb. (90 gm/m²).
Envelope Capacity: approximately 500 envelopes.
Envelope Sizes: #7¾, #9 and #10.
Envelope Weights: 13 lb. (50 gm/m²) through 24 lb. (90 gm/m²).
Color: Pebble Gray.
Net Weights: Operator Station—127 lbs. (57 kg). Printer—480 lbs. (216 kg).

Photograph shows design model.

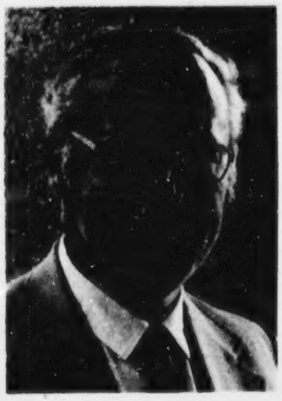
LIONEL V. BALDWIN

Lionel received his academic degrees in chemical engineering from the University of Notre Dame (BS, 1954, M.I.T.) (SM, 1955) and Case Institute of Technoloby (Ph.D., 1959). From 1955 to 1961, he performed research at the NACA/NASA Laboratory in Cleveland, Ohio. He moved to Colorado State University in 1961 as an associate professor to teach and continue his research in turbulent fluid flows. Since 1964, he has served as professor and dean of the College of Engineering. He has served as Chairman of the Board of Directors of AMCEE since 1976 to date.

MORRIS E. NICHOLSON

Morris E. Nicholson is Director of Continuing Education in Engineering and Science at the University of Minnesota. He is also Academic Coordinator for the University-Industry Television for Education (UNITE) network which broadcasts regular courses for industry. He is a member of the board of the Association for Media Based Continuing Education for Engineers. He has been active in continuing education programming for the American Society for Metals and the Corrosion Society N.A.C.E.

JOSEPH M. BIEDENBACH



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AMCEE VIDEOTAPED CATALOG AND ITS INTERNATIONAL IMPLICATIONS

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Introduction

The Association for Media-based Continuing Education for Engineers (AMCEE) has been described as an organization in other papers presented at this workshop. Nineteen member institutions have banded together to increase the availability of continuing engineering education programming to practicing engineers primarily within the borders of the United States.

One of the original concepts which led to the formation of AMCEE was that of providing televised continuing engineering education programming nationally (and internationally) by means of satellite. In the original conception of satellite distribution, we imagined shipping a videotape continuing engineering education program to an up-link transmitter location for transmission to a satellite. We imagined a satellite with high power transponders so that the rebroadcast by the satellite would be at a power level sufficient to allow ground stations of very modest cost to be able to receive the transponded signal. In this plan we imagined several industrial and academic locations around the country as having satellite ground stations tuned to receive the television-based continuing engineering education programming. Such a satellite distribution system could be extended easily to reach beyond the borders of the United States. The only constraint in the acceptability of such programming would be the general use of the english language for the audio portion of the programming. Using english as the broadcast language is not a severe constraint; in areas where it necessary, the received signal could be recorded and a local language audio track could be dubbed in.

The videotape distribution project discussed in this paper was proposed as a pilot to the satellite distribution program. The distribution of videotape-based continuing engineering education programming from the several member institutions of AMCEE provides a vehicle to test and to develop organizational procedures for identifying and reaching potential customers for such programming, for working out the interinstitutional financial and operational agreements, etc. Such a pilot program is desireable since satellite delivery system is complicated in terms of the organizational arrangements among the participating institutions.

This paper describes the operation of the videotape distribution project initiated by AMCEE in 1978. After this description, we offer a brief discussion of the international implications of the videotaped distribution project. We conclude the paper with an articulation of some of the questions which we recognize at this point in time.

USA Videotape Distribution Project

The idea for a catalog of videotapes from the AMCEE member institutions originated in late January 1978. In an amazingly short time, agreements among several member institution representatives were reached concerning catalog format, course pricing, and revenue sharing. All member institutions were contacted and made aware of the opportunity to list courses in the upcoming catalog. The Executive Director of AMCEE was charged to produce the catalog. Agreement was reached among the member representatives that the first catalog would contain only "live" classroom televised courses. We further agreed to offer these courses only on a non-credit basis; but to indicate that if academic credit was desired, the person with that desire should contact the local AMCEE school or the producing AMCEE school.

During the summer of 1978, eleven institutions elected to list courses in the catalog. A total of 172 classroom courses were listed in the catalog. Fourteen thousand copies were printed during the summer of 1978. Of these, 8,500 copies were printed with member institution names and logos on the covers and were distributed by the member institutions. Five thousand five hundred copies were printed with no member institution designation on the cover; these copies were distributed directly to engineers by AMCEE Headquarters. Generally speaking the Executive Headquarters distributed the AMCEE catalogs only in those geographical regions in the United States in which there is no institutional member. Of the 14,000 catalogs printed, each member institution was entitled to receive a maximum of 500 catalogs at no cost. Each member instition was able to order additional catalogs at a cost of $1.25 each. The member institutions took it upon themselves to distribute catalogs within their own geographical areas.

The agreements reached in late January 1978 concerning fiscal affairs included the following understandings:

(1) The cost for classroom instruction would be on the order of $50 per class hour. For that "book" price, a leasing client would be entitled to a ten day rental of one videotape of each class

period and one copy of any class handout materials associated with each class. The client would be free to reproduce the printed matter in whatever quantity necessary for the local viewing audience. The client would be billed for an additional $2.00 per tape to pay for the shipping and handling of the tape from the producing institution to the client. The client would also be expected to pay the shipping and handling of the tape from the client back to the producing institution.

(2) Sixty-five percent of the book price plus the $2.00 per tape would go to the producing institution for that institution to be responsible to provide the videotape and the shipping of the videotape to the client.

(3) The Executive Headquarters would take 15% of the book price in exchange for providing the catalogs and for doing the client billing and the dispersing of funds among the participating institutions.

(4) Twenty percent of the book price was allocated as a salesman's commission. The salesman's commission is available to the producing institution, Executive Headquarters, another member institution, or a designated AMCEE sales representative. That is, if an order from a client comes as a result of a catalog supplied by the producing institution, then the salesman's commission goes to the producing institution; if an order comes as a result of a catalog distributed directly by AMCEE, the sales commission goes back to AMCEE Headquarters; if an order comes as a result of another member institution's catalog, that other member institution receives the sales commission. In a few geographical areas of the United States, sales representatives, specifically designated as such by AMCEE Headquarters, are used; if an order results from catalogs distributed by a sales representative, the sales commission goes to that representative.

(5) The decision concerning faculty royalty percentages was left open within each producing institution. Within the several member institutions of AMCEE producing courses for distribution nationally, a variety of royalty arrangements have been worked out. While there is no uniformity from one institution's royalty arrangements to another, the range of author royalties run from a low of about 5% of book price to a high of 30% of book price.

(6) All institutional representatives agreed that the videotapes would be made available without academic credit as a part of their rental or lease agreement. Should any individual viewing any particular videotape course wish academic credit, that individual is (as always) free to negotiate with any appropriate academic institution for the granting of academic credit. It was agreed such negotiation would be considered separate and distinct from any videotape distribution arrangements made through or with AMCEE.

As of November 1, 1978 the first AMCEE catalog has resulted in 18 different organizations ordering 32 courses for a total dollar value of $54,740. Tables 1 and 2 below provide detailed information on the orders resulting from this first catalog. Table 1 shows each client, the course(s) ordered, the total dollar value of the order, and what organization received the sales commission on the order. Table 2 shows the producing institutions whose courses were ordered as a result of the first AMCEE catalog, the particular courses that were ordered and the total dollar value associated with the orders to each producing institution.

AMCEE Headquarters income on the $54,740 of gross income on videotape courses is something over $14,000.

Given that the first catalog was not available until mid-summer 1978 and given that many of the courses listed therein had order deadlines in August and September of 1978, we consider the sales production from this catalog to be outstanding. Nothing of this scale and magnitude has ever been attempted before. For 17 major universities to band together to cooperatively market instructional materials to industry is a new venture for all of us - us in the university and us in industry. Just as we in the university need time to adapt and to adjust to the opportunities available through cooperative action, so too, do those in industry need time to adjust and to adapt to the opportunity now available to them to access continuing engineering education programs from a multitude of individual institutions through one consortium.

Even before the first order was received from the first catalog, plans were underway for the production of the second catalog. Since we are providing videotapes of classroom instruction, it is necessary that at least two catalogs be produced each calendar year. A few changes were made in the second catalog as a result of comments received on the first catalog. The most significant change in the second catalog is that the second catalog contains within it announcements of short, non-credit continuing engineering education courses which were designed and produced specifically for videotape distribution. That is, catalog number 2 has more than just live credit classroom videotapes within it.

Catalog number 2 lists 224 courses produced (or to be produced) at 15 different member institutions. Fourteen thousand five hundred copies have been printed and are being distributed to potential industrial clients in November 1978. Nine thousand of these copies will be distributed by member institutions while five thousand five hundred will be distributed directly by AMCEE Headquarters. No changes are being made at this time in any of the financial understandings as agreed upon for the first catalog.

International Implications

The international implications of this videotape distribution project are obvious. Videotapes being produced and distributed by educational institutions within the United States; these videotapes are available for international use. Videotapes can be shipped easily across international borders. Anywhere that technical audiences with english language skills have need for continuing engineering programming, the AMCEE videotapes can meet the need. Where english language skills are not available, permission can be negotiated to provide for local language translation of the audio track. Other papers in this workshop refer more specifically to the details of international marketing of

CLIENT & COURSE(S)	SALE BY REP. OR DIRECT	ORDER TOTAL
BENDIX RESEARCH LABS, MICHIGAN Microprocessor Technology & Applications (CSU)	U. of MICH.	$ 6,709
COLLINS RADIO, IOWA Data Structures & Algorithms (IIT)	DIRECT	2,200
CUTLER-HAMMER, WISCONSIN Business & Technical Writing (CASE) Semiconductor Electronics (STANFORD)	DIRECT	2,000
GENERAL MILLS, MINNESOTA Time Management (USCal) Women Up the Management Ladder (USCal)	U. of MINN.	650
INTERNATIONAL PAPER COMPANY, TEXAS Time Management (USCal)	SMU	250
C.H. DEXTER CORP., CONNECTICUT Time Management (USCal)	DIRECT	250
DIAMOND POWER SPECIALTY CO., OHIO Dynamic Analysis (USCar)	CASE	1,500
MISSISSIPPI CHEMICAL COMPANY, MISSISSIPPI Chemical Process Analysis (USCar) Refrigeration & Air Conditioning (CSU)	DIRECT	2,800
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION, COLORADO Introduction to Microprocessors (ACE at STANFORD) Women Up the Management Ladder (USCal)	CSU	1,500
NAVAL AVIONICS CENTER, INDIANA Women Up the Management Ladder (USCal)	PURDUE	400
NAVAL WEAPONS CENTER, CALIFORNIA Stress-Strength-Strain (MICH) Polymeric Materials (MINN)	USCal	3,100
RECOGNITION EQUIPMENT, CALIFORNIA Data Communications (SMU)	SMU	1,500
NAVAL RESEARCH LABORATORY, WASHINGTON DC Acoustic Devices (STANFORD) Artificial Intelligence (MIT) Computer Architecture (USCar) Computer Image Processing (USCal) Fourier Transforms (STANFORD) Integrated Optics (AMCEE) Lasers (STANFORD) Microcomputers, Intro. to (ACE) Microprocessor Techniques & Applications (CSU) Systematic Programming (STANFORD) Programming Language Processors (MIT)	DIRECT	24,656
NORTHERN NATURAL GAS, NEBRASKA Biochemical Engineering (CSU)	DIRECT	2,000
RAYTHEON COMPANY, TENNESSEE Lasers (STANFORD)	USCar	1,500
UNION CAMP, GEORGIA Computer Control (USCar)	USCar	1,500
UNIVERSITY OF SOUTH CAROLINA, SC Soil Dynamics (MIT)	USCar	2,225
	TOTAL	$54,740

TABLE 1 CLIENTS AND COURSES ORDERED FROM FIRST AMCEE CATALOG

PRODUCING INSTITUTIONS AND COURSES	TOTAL ORDER
AMCEE	$ 8,691
Miscellaneous Printed Matter	
Integrated Optics (Univ. of Delaware)	
CASE WESTERN RESERVE UNIVERSITY	500
Business & Technical Writing	
COLORADO STATE UNIVERSITY	12,909
Microprocessor Technology (2)	
Refrigeration & Air Conditioning	
Biochemical Engineering	
ILLINOIS INSTITUTE OF TECHNOLOGY	2,220
Data Structure & Algorithms	
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	5,090
Artificial Intelligence	
Programming Language Processors	
Soil Dynamics	
SOUTHERN METHODIST UNIVERSITY	1,500
Data Communications	
STANFORD UNIVERSITY	10,700
Semiconductor Electronics	
Introduction to Microprocessors (ACE) (3)	
Acoustic Devices	
Fourier Transforms	
Lasers (2)	
Systematic Programming	
UNIVERSITY OF MICHIGAN	1,600
Stress-Strain-Strength	
UNIVERSITY OF MINNESOTA	1,500
Polymeric Materials	
UNIVERSITY OF SOUTH CAROLINA	6,000
Chemical Process Analysis	
Computer Architecture	
Computer Control	
Dynamic Analysis	
UNIVERSITY OF SOUTHERN CALIFORNIA	4,050
Women Up the Management Ladder (3)	
Time Management (3)	
Computer Image Processing	
TOTAL	$54,740

TABLE 2 PRODUCING INSTITUTIONS AND COURSES
ORDERED FROM FIRST AMCEE CATALOG

of educational materials. But it is important for us to elaborate in this paper on the details of international utilization of videotape courses listed in the AMCEE catalog.

Several of the member institutions already have an international distribution of their educational programming. Such institutions, as well as those not now having international distribution of programming, are and have been specifically encouraged by the AMCEE Board of Directors to make the AMCEE catalog available to any and all potential clients. The Board of Directors of AMCEE have agreed that the videotape programming should be used as widely as possible and the Board does not view the national boundary of the United States as a barrier to the flow of instructional programming from this country to international audiences.

Anyone desiring a copy of the AMCEE videotape catalog is encouraged to write to any member institutional representative or to write directly to AMCEE Executive Headquarters.

Conclusions

The original purpose of the AMCEE videotape catalog was to provide a vehicle by which the AMCEE institutions could work out the financial and operational details of sharing and distributing videotape-based instructional materials. The intent was that such videotape distribution would cease once distribution by satellite becomes a reality. But as is often the case in such ventures, it may be that videotape distribution of instructional materials will continue to be an important function of AMCEE even after video distribution of materials by satellite becomes a reality. The economic considerations are different for videotape distribution as compared to satellite distribution. It may be that economics will dictate the continued distribution of instructional materials by videotape for some situations.

With videotape distribution of the instructional materials a real opportunity exists for international sharing of technical instructional materials. The Board of Directors of AMCEE as well as all of the member representatives of the AMCEE institutions are excited and enthusiastic about the possibilities of international distribution. We are anxious to hear from other outside the United States to receive from them their comments concerning this project. Are there modifications that we need to consider in order to improve the foreign utility of videotape based continuing engineering education programming? Will the distribution of such programming be more or less desireable if done by satellite? How important is the fact that such programming is done in english?

We do not have all the answers. But AMCEE is moving forward with vigor.

ROBERT M. ANDERSON, JR.

Dr. Anderson is the Director of Continuing Engineering Education and the Ball Brothers Professor of Engineering at Purdue University. He is the Chairman of the interdisciplinary master's degree program departmental faculty and is responsible for liaison between Indiana industry and the Schools of Engineering. Professor Anderson holds his academic rank in the School of Electrical Engineering where he teaches and does research in two areas: 1) solid state materials and devices and 2) professionalism in engineering. He is also the Purdue Representative to the Association for Media-based Continuing Education for Engineers.

Dr. Anderson is a registered professional engineer in Indiana. He is a member of IEEE, ASEE, ASTD, and AAAS. He is listed in Who's Who in America, Who's Who in Engineering, and in American Men and Women of Science. Professor Anderson was educated at the University of Michigan where he earned his BSE(EE), MSE(EE), MS(Physics), and Ph.D. (EE).

Dr. Anderson is married to Janice Pendell and has two children: Erik Martin and Kristi Lynn.

MAKING THE MOST OF THE DIFFERENCES IN OBJECTIVES BETWEEN ACADEMIA AND INDUSTRY

Myron Tribus
Director, Center for Advanced Engineering Study
Massachusetts Institute of Technology
Cambridge, Massachusetts

Today, I want to talk to you about the mismatch between the aspirations of academia and industry and what we can do to take advantage of this mismatch.

Whenever a faculty of engineering is asked to help educate engineers, they begin by figuring out how they can deliver to the people beyond the walls of the campus the same material that they have prepared for use on campus. They understand in a vague sort of way that this material may not be what is wanted or needed. But the least adaptive response is to simply meet the new problem as though it were a very small variation in the daily work. I don't blame professors for feeling this way. In the first place, the entire reward system of most campuses and the self image that the faculty members develop is built around the teaching of undergraduate and graduate students. The environment is very well structured. The professors decide what is to be taught and to be learned, and they determine the standards to which the students must be held. The reward for the students is also very simple. If they don't do what they are told to do, they do not get a degree, and without the degree they will have difficulty finding employment.

Engineers in industry, however, are motivated differently than students. They seem to fall into three categories:

1. Some of them would like to obtain a credential as a means of widening career opportunities. They seek a degree program or at least some form of certification. Students in this category tend to be more like the students on campus, and it is possible for the professors to set up requirements for a degree and find some takers.
2. Some engineers simply want the information in order to do a particular job better than they can now do it.
3. Another group of engineers wants to learn something new--either as a means of meeting a demand placed upon the engineers by their organization or perhaps to capture an opportunity that they have recognized.

These three kinds of needs require different responses.

Those who seek a degree are either not very long out of school or were denied the opportunity at an earlier time and believe they have to make it up. A few are in organizations in which the Personnel Department places a very strong reliance on degrees. For example, in the government the chances for promotion through the Civil Service are related to degrees, and students occasionally have been known to take leave from their government jobs and spend a year at a university just to assure promotions. In general, these students are not much different than the on-campus students. There aren't very many of them. Faculties who try to meet the needs of continuing education by offering minor variations in an on-campus program don't have many takers.

A much larger demand is for help with immediate, real problems. In fact, for people with this need the distinction between a consultant and an educator is very small. A good consultant educates the client, and to them a good teacher is someone who teaches the engineer to solve real problems.

Serving these students is rather difficult for many professors--and for several reasons. In the first place, professors are rewarded because they are good at generalizing information. The highest achievement for a professor is to produce a new correlation or a new understanding about the relations among variables. In academia, generalization is considered glamorous and particularization to a specific application is considered mundane. But the engineer with a problem is seeking help in particularization. This then is the first mismatch. It is unfortunate that in so much of the literature there is a discussion of the difference between "theory" and"practice." Actually, the practicing engineer doesn't want subjects that are free of theory. His or her interest is in learning to put the theories to work.

As Bertrand Schwartz has put it: There is a big difference generating "knowledge" and "know-how." There is a difference between teaching knowledge and imparting the art of putting that knowledge to work. It is the difference between being able to solve "given" problems of the kind "given this--find that" and being able to define problems in ill-defined situations.

In the last 15 to 20 years, especially in the United States, engineering professors have tried to make their students partners in the development of theory. They have assumed that if a student knew the theory, the problems of application would take care of themselves. Now this certainly is true of classroom type problems, but in the world of engineering problems are not in the form "given this--find that." The problems themselves have to be defined, extracted, simplified, explored, simplified again, explained to others, combined with other problems, and worked through to practical solutions of just the right degree of accuracy with a minimum of cost. In such a situation, engineers--especially if they have been trained academically--may become lost and confused, unable to apply what they know, unable to decide what is important and what is insignificant. It is at this level that they need help, and it is at this level that the professors are least willing and anxious to give such help. The activity calls for particularization of knowledge--not the generalization of knowledge, and it is in this activity that professors are apt to feel the most insecure.

Professors are not entirely wrong to take the view that generalization of experience is important. The only way to avoid obsolescence is to learn to generalize from experience. In other words, though the demands of engineers is often for instruction on how to do a specific thing and they themselves often show no great interest in exploring the theoretical aspects of things, their own survival as professionally competent practioners requires them to learn to generalize.

Another way to say the same thing is to observe that professional development requires two kinds of activities:

1. The ability to particularize general knowledge and to apply it to a specific application.
2. The ability to understand daily experience and connect it to the more useful, generalized knowledge.

The engineer who fails to do the first will be on the way to sterility. He or she will be fit only to lecture in abstract terms to people who probably won't be applying what they are taught anyway. The engineer who fails to do the second task will become obsolete. As technology shifts with time, yesterday's experience will no longer be applicable. If the engineer has not connected these experiences to the world of wider knowledge, he or she will not be able to transfer experiences to a new situation and will be unfit for the new jobs as they turn up.

Before turning to how we may use this difference in perspectives in a positive way, let me bring out one more important difference in understanding and motivation between conventional teachers and engineers in industry.

There is a trap for the teacher who approaches engineers in industry after years in a conventional classroom. It's easy to fall into the trap of thinking that students from industry are just like graduate students on campus--only older and a little bit rusty. Actually, students on campus have made a different kind of compact with the educational institution than students in industry. Students on campus have committed large blocks of time to education. They have already decided that they are not going to earn money during this time--at least not more than enough to stay alive. They consider their first and only task the development of intellectual capital. At least this is the way professors are apt to treat the students; and although they may grumble, they fall in line because they haven't much choice. On the other hand, the adult learner places great value on his or her time. He or she usually has to support a family, to engage in civic activities, to hold down a full-time job, to be a parent.

In short, for the graduate or undergraduate student the tuition fee is a good measure of what the student thinks his education costs. For the practicing engineer, the tuition fee is usually small in comparison with the opportunity cost associated with the time demands of the study.

So the second great difference in perspective between professors of engineering and practicing engineers is the different way each regards the value of the other's time.

Based on these considerations, we have formulated principles to guide the development of new approaches to continuing education.

1. Presentations should be "problem oriented" and not "discipline oriented."
2. Presentations should be connected to the theoretical underpinnings, but the emphasis should be on how to go from the general to the particular--or more specifically, how to recognize and define the problem.
3. The presentation should put a high premium on the value of the student's time. Every possible aid to the student to enable him or her to skip ahead or to jump around in the material or to go more rapidly should be provided.
4. The program should keep before the student at all times how what is being taught is connected to the student's motivations.

Before discussing how to take these factors into account, we must turn our attention to the campus--for if we intend to work with professors on campus, we must keep in mind the rewards and penalties that are associated with their careers. At this point I can speak only for the situation in my own country. I am aware that in some other countries the constraints are rather different, and some things which we in the U.S.A. regard as barriers may not be barriers elsewhere.

One of the reasons professors of engineering are so interested in generalization is that in the United States we do not encourage schools to adopt a degree of high specialization. We do not know what our students will be doing when they graduate. We tend, therefore, to produce students with broad training. They find their way in industries and to jobs which probably didn't exist when they started their education. The U.S.A. still has a rather fluid society. It is not uncommon for an engineer to work in two or three industries during a career. So there is not much likelihood that an engineering professor will have specialized narrowly for one kind of application.

On the other hand, some other countries encourage specialization. There may be many students studying the problems of a specific industry such as the steel industry or the aluminum industry. In such circumstances it is possible for the students, faculty, and engineers in the factory to form a rather close liaison. In the U.S., on the other hand, where a fraction of the population in engineering is much less and the engineers are not prepared for any one industry in particular, it is unlikely that the professors will concentrate and, therefore, will particularize their knowledge to a unique set of industrial applications. Now whether our approach is better or not--I cannot say. So much depends upon the culture and history of the countries, the state of the industry, and so on. But I do know that the U.S. system does serve the country well even though a by-product is a mismatch between academia and industry of the sort I have already mentioned. And now what to do? Can we use technology to help?

Let me first discuss a technique based on the use of television.

In this approach, the teaching is done in the place of work. Local tutors are selected from the industry. The tutors are chosen because they are interested in helping the engineers in the factory and have competence in particularizing knowledge. They are selected because they are good problem solvers. These tutors are teamed with an academic person who is willing to prepare lectures on the theory underlining the applications. These lectures are videotaped for the use in the classroom in industry. The materials should be agreed upon beforehand, but they do not have to be heavily slanted towards application. They should be prepared with the thought that the lectures will be viewed by groups of students with their tutors--stopping the tapes to discuss the material at frequent intervals. The tutor can enhance and extend the lectures by giving examples from the daily work. Better yet, the tutor can help the students develop their own examples.

In this technique, the use of video has important advantages.

1. There is a saving of instructor's time. It is no longer necessary to travel to the place of work for each lecture. Furthermore, the lectures may be used over again with other companies. It is necessary for the professor to make the videotaped lectures in the first place. This is an added burden, but it only occurs once every few years.
2. The task of particularizing the material is not left to the professor. It is the job of the local tutor. Therefore, the connection between "knowledge" and "know-how" is made by the person most qualified to do so.
3. The local tutor does not have to prepare lectures or to organize the theoretical presentation. He or she only has to recall examples from the workplace or, better yet, to help the students to generate them. The local tutor plays more of the role of consultant than the role of a professor.

To take into account the value that the students place on their time, we have decided to experiment with what we call "mini courses." Ordinarily, a subject at M.I.T. is given in about 40 lectures. We have been working with members of the faculty to produce summary lectures which take about one-third as much time. Once a week the professor comes to the studio and speaks for one hour covering the materials that normally would be covered in three hours of lecture. When this tape is played in industry with a tutor, the students decide which portions of the material are particularly interesting to them; and with the help of the tutor they explore it.

The major difficulty associated with a program of this kind is the expense of finding out what people in industry really want to learn. When students come to the campus, they take from a menu that has been decided ahead of time by the faculty; and if they don't like what is offered, they stay away. On the other hand, when a program is to be offered in industry, it should be particularized insofar as possible to each industry. This is exceedingly difficult to do without a lot of study and contact with industry. In the coming years we plan, particularly in cooperation with AMCEE, to make these kinds of studies on a nationwide basis and use them to decide which videotapes to prepare and in what style to prepare them.

Now let me turn to a different approach that we are using--one that involves both the computer and television.

We call this program "Project PROCEED." Project PROCEED is based on the idea that engineeting knowledge can be prepared in modules rather than in full courses or lectures. A module is usually represented by a booklet of about 100 pages, and it requires about eight hours to master. The modules are connected to one another by an appropriate guide which helps the engineer with a problem to decide what it is he or she knows and what is yet to be learned.

We plan for the reference guide to be computer based. That is, it will use an interactive program so that the engineer can ask questions at a terminal, and based on these questions, be guided to the information needed. The computerized data base contains case histories as well as specific modular material.

For example, our first topic is "Energy Conservation in Industry." The engineer interested in this subject will approach our terminal and indicate which industry he or she is considering. The computer will list case histories in that industry. These case histories show what people with energy conservation problems have been doing. The computer will then, if requested to do so, provide legal, social, and economical data relating to the general energy conservation problem, either from the perspective of the global problem or from the perspective of a particular industry.

The computer program will also list the abstracts of various modules. For example, an engineer may wish to learn more about how to adjust the controls to conserve energy in a production process or how to make a calculation regarding the return on investment associated with a change in a design or perhaps how to design a system of heat exchangers for energy recovery. Whatever the problem, the computer is designed to guide the student to the necessary study materials. Some of these materials would be presented on a screen at the computer terminal--others will be sent by mail, depending on the request. In addition, the student will be referred to videotapes which are connected to the problem. For example, we have videotapes which take the viewer through a factory looking at opportunities to save energy. In another videotape, a designer takes the viewer through a solar home.

The characteristic of both of these programs is that they are adaptive to the local situation. In the first program, we tried to make general material useful to support a tutor who would be involved in adapting the general information to the specific problem. In the second approach, we have chosen a problem which occurs many times, and we have pulled together as much information as we can about the problem showing people how to particularize the general knowledge and deal with the problem they have at hand.

Both of these programs are new. We are unsure that they will prove to be economically viable, but we think they are based on sound reasoning--reasoning that takes into account that in continuing education we are not dealing with big children, we are dealing with adults who often know as much about their lives as we do and with whom we must have an entirely different relationship.

Thank you.

MYRON TRIBUS

Before M.I.T., Dr. Myron Tribus was a Senior Vice President for the Xerox Corporation, U.S. Assistant Secretary of Commerce for Science and Technology, Dean of the Thayer School of Engineering at Dartmouth College, Professor of Engineering at U.C.L.A. and a Captain in the U.S.A.F. He has published books and papers on heat transfer, thermodynamics, decision theory and design. The Center for Advanced Engineering Study reaches approximately 12,000 engineers worldwide with its programs of continuing education.

PROGRAM

CAMINO REAL HOTEL

TUESDAY — APRIL 24, 1979

9:00 a.m. - to 8:00 p.m. Conference Registration
Camino Real Hotel -
Conference Headquarters

6:00 p.m. to 8:00 p.m. Hospitality Area — Camino Real Hotel
"Meet Your Conference Colleagues"

WEDNESDAY — APRIL 25, 1979

8:00 a.m. - 9:00 a.m. Late Registration

9:00 a.m. - 10:00 a.m. Inauguration of Conference and Exhibit
Dr. Guillermo Soberón Acevedo, Rector
Universidad Nacional Autónoma de México
MEXICO

10:00 a.m. **SESSION I**
Moderator: Prof. Javier Jimenez-Espriu
Dean of Engineering
University of Mexico
Speaker: "The Super Industrial Revolution"
Alvin Toffler
Author of *Future Shock*
USA

11:00 a.m. - 11:30 a.m. Coffee Break

11:30 a.m. - 1:00 p.m. Discussion and Response led by a panel with questions from the floor.
Panel Members

Dr. Pierre Le Goff
Institut Polytechnique National
FRANCE

Raul Ortiz Ortiz
University of Mexico
MEXICO

Dr. Myron Tribus
Massachusetts Institute of Technology
USA

1:00 p.m. - 2:30 p.m. Lunch

2:30 p.m. - 4:00 p.m. **SESSION II**
Moderator: Professor Alfonso Henriquez De Brito
Cidade Universitaria
BRAZIL
Speaker: "Motivation In Adult Education"
Dr. Bertrand Schwartz
University of Paris
FRANCE

4:00 p.m. - 4:30 p.m. Coffee Break

4:30 p.m. - 6:00 p.m. **SESSION II**
Moderator: Dr. Jose A. Nieto Raminez
Dean of Graduate School of Engineering
University of Mexico
MEXICO
Speaker: "Government's Influence on Continuing Education"
Dr. Roger Diáz De Cossio
Director of Publications and Libraries
Secretaria de Educación Publica
MEXICO

7:00 p.m. Welcome Reception

THURSDAY — APRIL 26, 1979 — MORNING SESSIONS

(Three Concurrent Sessions)

Time	Group I Professional Society Programs Moderator: Vladimir Yackolev VENEZUELA	Group II University Programs Moderator: Prof. Zlatko Kostrencic Gradevinski Institut YUGOSLAVIA	Group III Industry/Government Programs Moderator: Dr. Joseph M. Biedenbach University of South Carolina USA
8:30-12:30	"A National Program" Mr. Hannu Laine Suomen Teknillinen Seura FINLAND	"A Latin American Center" Dr. Pedro Martinez Pereda Centro de Educacion Continua School of Engineering University of Mexico MEXICO	"An Individualized Instruction Approach to Continuing Education for Engineers by Industry" Frank B. Donalson NL Baroid USA
	"The Swedish Civil Engineers' Plan" Mr. Bertil Haard Sveriges Civilingenjorsforbund SWEDEN	"Industry-University Relations For A Successful Program" Dr. G. Brown and Audrey J. Perkins University of Surrey UNITED KINGDOM	"Bridging The Academic-Industrial Gap: General Electrics Entry-Level Process" Dr. Lindon E. Saline USA
10:00-10:30	Coffee Break	Coffee Break	Coffee Break
10:30-12:30	"Technican Training" Professor Moussa Bamba Director de la Scolarite IVORY COAST	"The University of Wisconsin Model" Professor John P. Klus University of Wisconsin-Extension USA	"Continuous Education In Agricultural Programs" Antonio Murrieta Necoechea Director de Delegaciones Estatales Secretaria de Comercio MEXICO
	"Professional Societies and Continuing Education in India" Professor A. Bhattacharyya Director, Indian Institute of Technology INDIA	"Continuing Education In Socialist Countries" Mr. T. Biernacki Rector, Politechniki Gdanskiej POLAND	"Continuing Education at Siemens" Dr. Ernst Golling Director of Engineering Education Siemens AG GERMANY
12:30-2:30	Lunch	Lunch	Lunch

ADDITIONAL PAPERS FOR AFTERNOON DISCUSSION

2 30- 6 00
Will be Printed
In Conference
Proceedings

"An International Professional Society's Approach On Continuing Education For Its Members"
John Wilhelm
Director of Educational Services
IEEE/USA

"A Traveling Road Show Concept For Continuing Education"
George Armitage
IEEE/CANADA

"Social, Political Obstacles to the Latin American Technological Development Its Impact in Up-To Date Professional Knowledge"
Dr Mecus Kapian
University of Mexico
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"Evening Programs In India"
Dr N L Kachhare
H B Technological Institute
INDIA

"The Argentina Experience"
Professor Marcelo A Sobrevila
National University of Buenos Aires
ARGENTINA

"Denmarks Experience"
Professor Niels Krebs Ovesen
Danish Engineering Academy
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"Continuing Education In A Large Telecommunications Research and Development Establishment"
Dr C R Wischmeyer
Bell Laboratories
USA

"UPDATE '7X - A Successful Technical Vitality Program"
Gary L Pastre
Program Manager of Advanced Education
IBM

"A Residential Setting For Technical Training For Personnel Of A Large Corporation"
Charles Sener, Director
Bell Systems Center For Technical Education
USA

"A Case Study On A Successful Industry — University Solution to A Continuing Engineering Education Program"
Eugene C Benbow
John Van Horn
Westinghouse Electric Corporation

THURSDAY — APRIL 26, 1979 — AFTERNOON SESSION
(Five Concurrent Sessions)

Group discussions will be based on the morning presentations, additional papers, and conference proceedings. The intent for each discussion group is to review the state of the art in each area, to include international views, and to draw on subject matter specialists for their expertise. Information from the groups will be assimilated into a document useful to program planners and published after the conference.

Time	Group	Topic To Be Discussed	Session Chairman
2 30-3 30	A	Methods of Need Analysis Continuing Education Programs	Dr Myron Chin University of the West Indies TRINIDAD
	B	Promotion Techniques For Continuing Education Programs	Dr Sabah Al-Nassari University of Technology IRAQ
	C	Costs Associated With Continuing Education Programs	Dean Richard Kenyon Rochester Institute of Technology USA
	D	Staffing Requirements For Continuing Education Programs	Dr Moti Lal Jain Thapar Institute of Engineering and Technology INDIA
	E	Evaluation Of Continuing Education Programs	Dr A M Zahoorul Huq Bangladesh University of Engineering and Technology BANGLADESH
3 30-4 00		Coffee Break	
4 00-6 00		Group Discussions Continue	

FRIDAY — APRIL 27, 1979 — MORNING SESSIONS
(Three Concurrent Sessions)

Time	Group I	Group II	Group III
	Moderator Prof Johann L Atrops Center Technology In The Tropics WEST GERMANY	Moderator Dr D L Mordell President Canadian College of Advanced Engineering Practice CANADA	Moderator Dr M Maqusi University of Jordan JORDAN
8 30-10 30	"The Importance of Continuing Education For Inspectors" Profesor A F Rashed and Dr M A Metwally Alexandria University EGYPT	"Engineers/Managers In Europe" Professor H Eric Frank University of Bath UNITED KINGDOM	"Power Engineering Programs In The USSR" Dr Victor Bespalov Moscow Power Engineering Institute USSR

	"Measuring The Effectiveness Of A Joint Thai — Japan Program" Dr. Prasit Prapinmongkolkarn Chulalongkorn University THAILAND	"An Undergraduate Program Designed Designed For Lifelong Learning" Dr. E. T. Cranch President, Worcester Polytechnic Institute USA	"A Program For Control Education And Training In Large Industrial Complexes" S.A.K. El-Sheshe, A. G. Hamdy and S.E. Aidarous EGYPT
10:30-11:00	Coffee Break	Coffee Break	Coffee Break
11:00-12:30	"Appropriate Education For Nigerian Engineers" Dr. Swaminathan Madhu Rochester Institute of Technology USA	"An Approach To Public Works Continuing Education" Eng. Francisco Beltran Secretary of Human Settlements and Public Works MEXICO	"Energy Use And The Role Of Continuing Education" Dr. Marc Pelegrin Director of ENSAE FRANCE
	"Sanitary Engineering For World Health (TDS)" Eng. Edmundo Elmore General Secretary, Inter American Sanitary and Environmental Engineering Association PERU	"A Joint Videotaped Training Program" Dr. James Rogers Case Western Reserve University USA	"Self Development In Agriculture Through Lifelong Learning" Dr. John Holden Graduate School United States Department of Agriculture
12:30- 2:30	Lunch	Lunch	Lunch

ADDITIONAL PAPERS FOR DISCUSSION

"Support For Continuing Education In A Developing Country" Professor O. N. Wakhlu Regional Engineering College INDIA	"Structuring Continuing Education In New Zealand" Dr. Robert G. Norman Ministry of Public Works NEW ZEALAND	"Computerized Access To Engineering Information" Nancy Hardy Engineering Index USA
"A National Program For Oil And Petrochemical Industries In Venezuela" Effrain Barberii Technical Manager Vladimir Yackovlev, VP INATET VENEZUELA	"A Learning Model" Dr. Samuel Dubin Pennsylvania State University USA	"A Mathematical Model" Professor Pierre Le Goff Director, CPIC J. C. Charpentier, CPIC FRANCE and M. Sallaly Cairo University EGYPT
"Certification Programs In Business And Technical Disciplines" Roy W. Haley American Production and Inventory Control Society USA	"Professional Reference Programs" Henry N. Oppenheimer MGI Management Institute USA	"An External Graduate Program" Dean Griffith, Oklahoma State University Dr. B. E. Gilliland Clemson University USA
		"A Satellite Project" Dr. Myron Chin University of the West Indies

FRIDAY — APRIL 27, 1979

2:30 p.m. - 4:30 p.m. SESSION IV

Moderator: Ing. G. Etienne
PAHO
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Speaker: "The French Continuing Education Law"
Dr. Bernard Hauser
Ministere de l'Industrie
FRANCE

Speaker: "Developing a National Need Analysis"
Dr. Samuel B. Gould

USA

4:30 p.m. - 5:00 p.m. Panel Discussion

8:00 p.m. Reception and Banquet, Palacio de Mineria

PRE-CONFERENCE WORKSHOPS

Two workshops are scheduled immediately preceding the conference from 1:30 p.m. to 5:00 p.m. on Tuesday, April 24, 1979, in the Camino Real Hotel. All World Conference registrants are cordially invited to attend at no additional charge. The workshops will be conducted in English on Media-Based Continuing Education For Engineers and Individualized Instruction Programs For Continuing Education Of Engineers.

Workshop I
MEDIA-BASED CONTINUING EDUCATION FOR ENGINEERS

Workshop Leaders: Lionel V. Baldwin
Colorado University

J. David Waugh
University of South Carolina

"A Decade of U.S. Engineering Education Outreach By Video"
Hal F. Schulte, Jr.
University of Michigan

"The AMCEE Background and Status of Overall Activity"
Jack Mirnushian
University of Southern California

"AMCEE National Tape Distribution Project and Implications For International Coop"
R. M. Anderson, Jr.
Purdue University

"Marketing Continuing Education Materials World-Wide"
John Fitch
Massachusetts Institute of Technology

"Media-Based Continuing Education Pedagogy"
Myron Tribus
Massachusetts Institute of Technology

"Satellites for International Continuing Engineering Education"
Kenneth S. Down
Stanford University

"Modern Information Services for World-Wide Continuing Education"
Lionel V. Baldwin
Colorado State University
Joseph M. Biedenbach
University of South Carolina
Morrie E. Nicholson, Jr.
University of Minnesota

"Design and Production of a 45-Hour Bi-Lingual Videotaped Technical Training Program"
James L. Rogers
Case Western Reserve University

"Technologically-Aided Engineering Education of the Future"
William Kincheloe
Stanford University

Workshop II
PERSONALIZED CONTINUING ENGINEERING EDUCATION (PCEE)

Organizing And Implementing A Program, An Overview For Program Planners And Administrators

Workshop Leaders: Dean Griffith
Oklahoma State University

John Cantwell
Sandia Laboratories

PCEE refers to a program of continuing education which generally have the following characteristics: Instruction is drawn from text and other media material rather than lectures, students decide the rate and pace for mastering course materials, and mastery standards are keyed to demonstrate performance of specific behavioral objectives.

The content of this workshop will focus on:

1. How PCEE differs from conventional academic institution
2. Advantages and disadvantages of PCEE
3. Examples of materials used
4. Discussion of PCEE programs which are operating in industry, government, professional associations and universities
5. Procedures for starting a PCEE program

At the conclusion of the workshop participants should be able to assess whether and how they can implement a PCEE program.

APPENDIX

Author/Session Chairman Address List

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PROGRAM AT A GLANCE

First World Conference on Continuing Engineering Education
Mexico City — April 25-27, 1979

TIME	TUESDAY April 24, 1979	WEDNESDAY - APRIL 25, 1979		THURSDAY - APRIL 26, 1979		FRIDAY 27, 1979		TIME
		Session	Topic	Session	Topic	Session	Topic	
8:30 - 10:30 A.M.	CONFERENCE REGISTRATION - CAMINO REAL HOTEL 9:00 A.M. TO 8:00 P.M.	INAGURATION OF CONFERENCE AND EXHIBIT (9:00 - 10:00 A.M.)		4A	PROFESSIONAL SOCIETY PROGRAMS ● A National Program ● The Swedish Civil Engineers Plan ● Technician Training ● Professional Societies and Continuing Education in India	6A	GROUP I ● The Importance of Continuing Education For Inspectors ● Measuring The Effectiveness Of A Joint Thai - Japan Program ● Appropriate Education For Nigerian Engineers ● Sanitary Engineering For World Health (TDS)	8:30-10:30 A.M.
		1	THE SUPER INDUSTRIAL REVOLUTION ALVIN TOFFLER AUTHOR: FUTURE SHOCK	4B	UNIVERSITY PROGRAMS ● A Latin American Center ● Industry-University Relations For A Successful Program ● The University of Wisconsin Model ● Continuing Education In Socialist Countries	6B	GROUP II ● Engineers/Managers in Europe ● An Undergraduate Program Designed For Lifelong Learning ● An Approach To Public Works Continuing Education ● A Joint Videotaped Training Program	
				4C	INDUSTRY/GOVERNMENT PROGRAMS ● An Individualized Instruction Approach to Continuing Education for Engineers by Industry ● Bridging The Academic-Industrial Gap General Electrics Entry-Level Process ● Continuous Education in Agricultural Programs ● Continuing Education at Siemens	6C	GROUP III ● Power Engineering Programs In The USSR ● A Program for Control Education And Training In Large Industrial Complexes ● Energy Use And The Role Of Continuing Education ● Self Development in Agriculture Through Lifelong Learning	
10:00-10:30			COFFEE BREAK (11:00 - 11:30)		COFFEE BREAK		COFFEE BREAK	10:00-10:30
10:30-12:30 P.M.		1A	CONTINUATION OF SESSION 1 ABOVE PANEL DISCUSSION	4A 4B 4C	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)	6A 6B 6C	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)	10:30-12:30 P.M.
12:30 - 2:30			LUNCH (1:00 - 2:30)		LUNCH		LUNCH	12:30 - 2:30
2:30 - 3:30 P.M.	WELCOME TO THE CONFERENCE	2	● MOTIVATION IN ADULT EDUCATION	5A	Methods of Need Analysis Continuing Education Programs	7	● THE FRENCH CONTINUING EDUCATION LAW ● DEVELOPING A NATIONAL NEED ANALYSIS	2:30 - 3:30 P.M.
				5B	Promotion Techniques For Continuing Education Programs			
				5C	Costs Associated With Continuing Education Programs			
				5D	Staffing Requirements For Continuing Education Programs			
				5E	Evaluation of Continuing Education Programs			
3:30 - 4:00			COFFEE BREAK (4:00 - 4:30)		COFFEE BREAK			3:30 - 4:00
4:00 - 6:00 P.M.		3	● GOVERNMENT'S INFLUENCE ON CONTINUING EDUCATION	5A 5B 5C 5D 5E	CONTINUATION OF SESSION TOPICS NOTED ABOVE (DISCUSSION)		PANEL DISCUSSION	4:00 -6:00 P.M.
7:00 - 8:00 P.M.			WELCOME RECEPTION		ON YOUR OWN IN MEXICO CITY			7:00 - 8:00 P.M.
8:00 - ? P.M.							RECEPTION AND BANQUET PALACIO DE MINERIA	8:00 - ? P.M.